THE

POPULAR SCIENCE MONTHLY.

OCTOBER, 1895.

NEW CHAPTERS IN THE WARFARE OF SCIENCE.

XX.—FROM THE DIVINE ORACLES TO THE HIGHER CRITICISM.

By ANDREW DICKSON WHITE, LL. D. (Yale), Ph. D. (Jena),
FORMERLY PRESIDENT OF CORNELL UNIVERSITY.

V. VICTORY OF THE SCIENTIFIC AND LITERARY METHODS.

WHILE the struggle for the new truth was going on in various fields, aid appeared from a quarter whence it was least expected. The great discoveries by Layard and Botta in Assyria were supplemented by the researches of George Smith, Oppert, Sayce, and others, and thus it was revealed beyond the possibility of doubt that the accounts of the Creation, the tree of life in Eden, the institution of the Sabbath, the deluge, the Tower of Babel, and much else in the Pentateuch were simply an evolution out of earlier myths, legends, and chronicles. So perfect was the proof of this that the most eminent scholars in the foremost Christian seats of learning were obliged freely to acknowledge it.

The more general conclusions which were thus given to biblical criticism were all the more impressive from the fact that they had been revealed by various groups of earnest Christian scholars working on different lines, by different methods, and in various parts of the world. Very honorable was the full and frank testimony to these results given in 1885 by the Rev. Francis Brown, a professor in the Presbyterian Theological Seminary at New York. In his admirable though brief book on Assyriology, starting with the declaration that "it is a great pity to be afraid of facts," he showed how Assyrian research testifies in many ways to the historical value of the Bible record; but at the same time he freely allowed to Babylonian history an an-

tiquity fatal to the sacred chronology of the Hebrews. He also cast aside a mass of doubtful apologetics and dealt frankly with the fact that very many of the early narratives in Genesis belong to the common stock of ancient tradition, and, mentioning as an example the cuneiform inscriptions which record a story of the Accadian king Sargon—how "he was born in retirement, placed by his mother in a basket of rushes, launched on a river, rescued and brought up by a stranger, after which he became king"—he did not hesitate to remind his readers that Sargon lived a thousand years before Moses; that this story was told of him several hundred years before Moses was born; and that it was told of various other important personages of antiquity. The professor dealt just as honestly with the inscriptions which show sundry statements in the book of Daniel to be unhistorical; candidly making admissions which but a short time before would have filled orthodoxy with horror.

A few years later came another testimony even more striking. Early in the last decade of the nineteenth century it was noised abroad that the Rev. Professor Sayce, of Oxford, the most eminent Assyriologist and Egyptologist of Great Britain, was about to publish a work in which what is known as the "higher criticism" was to be very vigorously and probably destructively dealt with in the light afforded by recent research among the monuments of Assyria and Egypt. The book was looked for with the most eager expectation by the supporters of the traditional view of Scripture; but, when it appeared, the exultation of the traditionalists was speedily changed to dismay. For Prof. Sayce, while showing some severity toward sundry minor assumptions and assertions of biblical critics, confirmed all their more important conclusions which properly fell within his province. A few of the statements of this champion of orthodoxy may be noted. He allowed that the week of seven days and the Sabbath rest are of Babylonian origin; indeed, that the very word "Sabbath" is Babylonian; that there are two narratives of Creation on the Babylonian tablets, wonderfully like the two leading Hebrew narratives in Genesis, and that the latter were undoubtedly drawn from the former; that the "garden of Eden" and its mystical tree were known to the inhabitants of Chaldæa in pre-Semitic days; that the beliefs that woman was created out of man, and that man by sin fell from a state of innocence, are drawn from very ancient Chaldæan-Babylonian texts; that Assyriology confirms the belief that the book Genesis is a compilation; that portions of it are by no means so old as the time of Moses; and that the story of Joseph and Potiphar's wife was drawn in part from the old Egyptian tale of The Two Brothers. Finally, after a multitude of other concessions, Prof. Sayce al-

lowed that the book of Jonah, so far from being the work of the prophet himself, can not have been written until the Assyrian Empire was a thing of the past; that the book of Daniel contains serious mistakes; that the so-called historical chapters of that book so conflict with the monuments that the author can not have been a contemporary of Nebuchadnezzar and Cyrus; that "the story of Belshazzar's fall is not historical"; that the book must have been written at a period later than that of Alexander the Great; and that it associates persons and events which are really many years apart. He also acknowledged that the book of Esther "contains many exaggerations and improbabilities, and is simply founded upon one of those same historical tales of which the Persian chronicles seem to have been full." Great was the dissatisfaction of the traditionalists with their expected champion; well might they repeat the words of Balak to Balaam, "I took thee to curse mine enemies, and behold! thou hast blessed them altogether."*

No less fruitful have been modern researches in Egypt. While, on one hand, they have revealed a very considerable number of geographical and archæological facts proving the good faith of the narratives entering into the books attributed to Moses, and have thus made our early sacred literature all the more valuable, they have at the same time revealed the limitations of the sacred authors and compilers. They have brought to light facts utterly disproving the sacred Hebrew date of creation and the

---

* For Prof. Brown's discussion, see his Assyriology, its Use and Abuse in Old Testament Study, New York, 1885, *passim*. For Prof. Sayce's views, see The Higher Criticism and the Monuments, third edition, London, 1894, and especially his own curious anticipation, in the first lines of the preface, that he must fail to satisfy either side. For the declaration that the "higher critic" with all his offenses is no worse than the orthodox "apologist," see p. 21. For important admission that the same criterion must be applied in researches into our own sacred books as into others, and even into the mediæval chronicles, see p. 26. For justification of critical skepticism regarding the history given in the book of Daniel, see pp. 27, 28, also chap. xi. For very full and explicit statements, with proofs, that the "Sabbath," both in name and nature, was derived by the Hebrews from the Chaldæans, see pp. 74 *et seq.* For a very full and fair acknowledgment of the "Babylonian element in Genesis," see chap. iii, including the statement that the expression in our sacred book, "The Lord smelled a sweet savor," at the sacrifice made by Noah, is "identical with that of the Babylonian poet," and "it is impossible to believe that the language of the latter was not known to the biblical writer," on p. 119. For an excellent summary of the work, see Dr. Driver's article in the Contemporary Review for March, 1894. For the inscription on the Assyrian tablets relating in detail the exposure of King Sargon in a basket of rushes, his rescue and rule, see George Smith, Chaldæan Account of Genesis, Sayce's edition, London, 1880, pp. 319, 320. For the derivation of the Hebrew Sabbath, not only the institution but the name, from the Chaldæan, see ibid., p. 308. For various other points of similar interest see ibid., *passim*, especially chaps. xvi and xvii; also Jensen, Die Kosmologie der Babylonier, and Schrader, The Cuneiform Inscriptions and the Old Testament; also Lenormant, Origines de l'Histoire.

main framework of the early biblical chronology; they have shown the suggestive correspondence between the ten antediluvian patriarchs in Genesis and the ten early dynasties of the Egyptian gods, and have placed by the side of these the ten antediluvian kings of Chaldæan tradition, the ten heroes of Armenia, the ten primeval kings of Persian sacred tradition, the ten "fathers" of Hindu sacred tradition, and multitudes of other tens, throwing much light on the manner in which the sacred chronicles of ancient nations were generally developed.

These scholars have also found that the legends of the plagues of Egypt are in the main but natural exaggerations of what occurs every year; as, for example, the changing of the water of the Nile into blood—evidently suggested by the phenomena exhibited every summer, when, as various eminent scholars, and, most recent of all, Maspero and Sayce, tell us, "about the middle of July, in eight or ten days the river turns from grayish blue to dark red, occasionally of so intense a color as to look like newly shed blood." These modern researches have also shown that some of the most important features in the legends can not possibly be reconciled with the records of the monuments; for example, that the Pharaoh of the Exodus was certainly not overwhelmed in the Red Sea. As to the supernatural features of the Hebrew relations with Egypt, even the most devoted apologists have become discreetly silent.

Egyptologists have also translated for us the old Nile story of The Two Brothers, and have shown, as we have already seen, that one of the most striking parts of our sacred Joseph legend was drawn from it; they have been obliged to admit that the story of the exposure of Moses in the basket of rushes, his rescue, and subsequent greatness, is a story told not only of King Sargon, but of various other great personages of the ancient world; they have published plans of Egyptian temples and copies of the sculptures upon their walls, revealing the earlier origin of some of the most striking features of the worship and ceremonial claimed to have been revealed especially to the Hebrews; they have given to the world copies of the Egyptian texts showing that the theology of the Nile was one of various fruitful sources of later ideas, statements, and practices regarding the brazen serpent, the golden calf, trinities, miraculous conceptions, incarnations, resurrections, ascensions, and the like, and that Egyptian sacro-scientific ideas contributed to early Jewish and Christian sacred literature statements, beliefs, and even phrases regarding the Creation, astronomy, geography, magic, medicine, diabolical influences, with a multitude of other ideas, which we also find coming into early Judaism in greater or less degree from Chaldæan and Persian sources.

But Egyptology, while thus aiding to sweep away the former conception of our sacred books, has aided biblical criticism in making them far more precious; for it has shown them to be a part of that living growth of sacred literature whose roots are in all the great civilizations of the past, and through whose trunk and branches are flowing the currents which are to infuse a higher religious and ethical life into the civilizations of the future.*

But while archæologists thus influenced enlightened opinion, another body of scholars rendered services of a different sort—the center of their enterprise being the University of Oxford. By their efforts was presented to the English-speaking world a series of translations of the sacred books of the East, which showed the relations of the more Eastern sacred literature to our own, and proved that in the religions of the world the ideas which have come as the greatest blessings to mankind are not of sudden

---

* For general statements of agreements and disagreements between biblical accounts and the revelations of the Egyptian monuments, see Sayce, The Higher Criticism and the Monuments, especially chap. iv. For discrepancies between the Hebrew sacred accounts of Jewish relations with Egypt and the revelations of modern Egyptian research, see Sharpe, History of Egypt; Flinders Petrie, History of Egypt; and especially Maspero and Sayce, The Dawn of Civilization in Egypt and Chaldæa, London, published by the Society for Promoting Christian Knowledge, 1894. For the statement regarding the Nile, that about the middle of July "in eight or ten days it turns from grayish blue to dark red, occasionally of so intense a color as to look like newly shed blood," see Maspero and Sayce, as above, p. 23. For the relation of the Joseph legend to the Tale of Two Brothers, see Sharpe and others cited. For examples of exposure of various great personages of antiquity in their childhood, see G. Smith, Chaldæan Account of Genesis, Sayce's edition, p. 320. As to Trinities in Egypt and Chaldæa, see Maspero and Sayce, especially pp. 104–106, p. 175, and pp. 659–663. For miraculous conception and birth of sons of Ra, ibid., pp. 388, 389. For ascension of Ra into heaven, ibid., pp. 167, 168; for resurrections, see representations in Lepsius, Prisse d'Avennes, *et al.*; and for striking resemblance between Egyptian and Hebrew ritual and worship, and especially the ark, cherubim, ephod, Urim and Thummim, and wave offerings, see same, *passim*. For very full exhibition of the whole subject, see Renan, Histoire du Peuple Israel, vol. i, chap. xi. For Egyptian and Chaldæan ideas in astronomy, out of which Hebrew ideas of "the firmament," "pillars of heaven," etc., were developed, see text and engravings in Maspero and Sayce, pp. 17 and 543. For creation of man by a divine being in Egypt out of clay, see Maspero and Sayce, p. 154; for a similar idea in Chaldæa, see ibid., p. 545; and for the creation of the universe by a word, ibid., pp. 146, 147. For Egyptian and Chaldæan ideas on magic and medicine, dread of evil spirits, etc., anticipating those of the Hebrew Scriptures, see Maspero and Sayce, as above, pp. 212–214, 217, 636; and for extension of these to neighboring nations, pp. 782, 783. For visions and use of dreams as oracles, ibid., p. 641 and elsewhere. See also, on these and other resemblances, Lenormant, Origines de l'Histoire, vol. i, *passim*; see also George Smith and Sayce, as above, chaps. xvi and xvii, for resemblances especially striking, combining to show how simple was the evolution of many Hebrew sacred legends and ideas out of those of earlier civilizations. For an especially interesting presentation of the reasons why Egyptian ideas of immortality were not seized upon by the Jews, see the Rev. Barham Zincke's work upon Egypt. For the sacrificial vessels, temple rites, etc., see the bas-reliefs figured by Lepsius, Prisse d'Avennes, Mariette, Maspero, *et al.*

revelation or creation, but of slow evolution out of a remote past.

The facts thus shown did not at first elicit much gratitude from supporters of traditional theology, and perhaps few things brought more obloquy on Renan, for a time, than his statement of the simple fact that "the influence of Persia is the most powerful to which Israel was submitted." But this was now seen to be strictly true. Not only was it made clear by study of the Zend Avesta that the Old and New Testament ideas regarding Satanic and demoniacal modes of action were largely due to Persian sources, but it was also shown that the idea of immortality was mainly developed in the Hebrew mind during the close relations of the Jews with the Persians. Nor was this all. In the Zend Avesta were found in earlier form sundry myths and legends which, judging from their frequent appearance in early religions, grow naturally about the history of the adored teachers of our race. Typical among these was the Temptation of Zoroaster.

It is a fact very significant and full of promise that the first large, frank, and explicit revelation regarding this whole subject in form available for the general thinking public was given to the English-speaking world by an eminent Christian divine and scholar—the Rev. Dr. Mills. Having already shown himself by his translations a most competent authority on the subject, he in 1894 called attention, in a review widely read, to "the now undoubted and long since suspected fact that it pleased the Divine Power to reveal some of the important articles of our Catholic creed first to the Zoroastrians, and through their literature to the Jews and ourselves." Among these beliefs Dr. Mills traced out very conclusively many Jewish doctrines regarding the attributes of God, and all, virtually, regarding the attributes of Satan. There, too, he found accounts of the Miraculous Conception, Virgin Birth, and Temptation of Zoroaster. As to the last, Dr. Mills showed a series of striking coincidences with our own later account. As to its main features, he showed that there had been developed among the Persians, many centuries before the Christian era, the legend of a vain effort of the arch-demon, one seat of whose power was the summit of Mount Arezura, to tempt Zoroaster to worship him; of an argument between tempter and tempted, and of Zoroaster's refusal; and the doctor continued: "No Persian subject in the streets of Jerusalem, soon after or long after the Return, could have failed to know this striking myth." Dr. Mills then went on to show that, among the Jews, "the doctrine of immortality was scarcely mooted before the later Isaiah —that is, before the captivity—while the Zoroastrian scriptures are one mass of spiritualism, referring all results to the heavenly or to the infernal worlds." He concludes by saying that, as re-

gards the Old and New Testaments, "the humble, and to a certain extent prior, religion of the Mazda worshipers was useful in giving point and beauty to many loose conceptions among the Jewish religious teachers, and in introducing many ideas which were entirely new, while, as to the doctrines of immortality and resurrection—the most important of all—it positively determined belief."*

Even more extensive were the revelations made by scientific criticism applied to the sacred literature of southern and eastern Asia. The resemblances of sundry fundamental narratives and ideas in our own sacred books with those of Buddhism were especially suggestive.

Here, too, had been a long preparatory history. The discoveries in Sanskrit philology made in the latter half of the eighteenth century and the first half of the nineteenth, by Sir William Jones, Carey, Wilkins, Foster, Colebrooke, and others, had met at first with some opposition from theologians. The declaration by Dugald Stewart that the discovery of Sanskrit was fraudulent, and its vocabulary and grammar patched together out of Greek and Latin, showed the feeling of the older race of biblical students. But researches went on. Bopp, Burnouf, Lassen, Weber, Whitney, Max Müller, and others continued the work during the nineteenth century. More and more evident became the sources from which many ideas and narratives in our own sacred books had been developed. Studies in the sacred books of Brahminism, and in the institutions of Buddhism, the most widespread of all religions, its devotees outnumbering those of all branches of the Christian Church together, proved especially fruitful in facts relating to general sacred literature and early European religious ideas.

---

* For the passages in the Vendidad of special importance as regards the Temptation Myth, see Fargard, xix, 18, 20, 26, also 140, 147. Very striking is the account of the Temptation in the Pelhavi version of the Vendidad. The devil is represented as saying to Zaratusht (Zoroaster), "I had the worship of thy ancestors, do thou also worship me." I am indebted to Prof. E. P. Evans, formerly of the University of Michigan, but now of Munich, for a translation of the original text from Spiegel's edition. For a good account, see also Haug, Essays on the Sacred Language, etc., of the Parsees, edited by West, London, 1884, pp. 252 *et seq.* See also Mills's and Darmesteter's work in Sacred Books of the East. For Dr. Mills's article referred to, see his Zoroaster and the Bible, in The Nineteenth Century, January, 1894. For the citation from Renan, see his Histoire du Peuple Israel, tome xiv, chap iv; see also, for Persian ideas of heaven, hell, and resurrection, Haug, as above, pp. 310 *et seq.* For an interesting *résumé* of Zoroastrianism, see Laing, A Modern Zoroastrian, chap. xiii, London, eighth edition, 1893. For the Buddhist version of the judgment of Solomon, etc., see Fausböll, Buddhist Birth Stories, translated by Rhys Davids, London, 1880, vol. i, p. 14, and following. For very full statements regarding the influence of Persian ideas upon the Jews during the captivity, see Kohut, Ueber die jüdische Angelologie und Daemonologie in ihren Abhängigkeit von Parsismus, Leipsic, 1866.

Noteworthy in the progress of this knowledge was the work of Fathers Huc and Gabet. In 1839 the former of these, a French Lazarist priest, set out on a mission to China. Having prepared himself at Macao by eighteen months of hard study, and having arrayed himself like a native, even to the wearing of the queue and the staining of his skin, he visited Pekin and penetrated Mongolia. Five years later, taking Gabet with him, both disguised as Lamas, he began his long and toilsome journey to the chief seats of Buddhism in Thibet, and after two years of fearful dangers and sufferings accomplished it. Driven out finally by the Chinese, Huc returned to Europe in 1852, having made one of the most heroic, self-denying, and, as it turned out, one of the most valuable efforts in all the noble annals of Christian missions. His accounts of these journeys, written in a style simple, clear, and interesting, at once attracted attention throughout the world. But far more important than any services he had rendered to the Church he served was the influence of his book upon the general opinions of thinking men. For he completed a series of revelations made by earlier, less gifted, and less devoted travelers, and brought to the notice of the world the amazing similarity of the ideas, institutions, observances, ceremonies, and ritual, and even the ecclesiastical costumes of the Buddhists to those of his own Church.

Buddhism was thus shown with its hierarchy, in which the Grand Lama, an infallible representative of the Most High, is surrounded by its minor Lamas, much like cardinals, with its bishops wearing mitres, its celibate priests with shaven crown, cope, dalmatic, and censer, its cathedrals with clergy gathered in the choir; its vast monasteries filled with monks and nuns vowed to poverty, chastity, and obedience; its church arrangements, with shrines of saints and angels; its use of images, pictures, and illuminated missals; its service, with a striking general resemblance to the Mass; antiphonal choirs; intoning of prayers; recital of creeds; repetition of litanies; processions; mystic rites and incense; the offering and adoration of bread upon an altar lighted by candles; the drinking from a chalice by the priest; prayers and offerings for the dead; benediction with outstretched hands; fasts, confessions, and doctrine of purgatory—all this and more was now clearly revealed. The good father was evidently staggered by these amazing facts; but his robust faith soon gave him an explanation: he suggested that Satan, in anticipation of Christianity, had revealed to Buddhism this divinely constituted order of things. This naïve explanation did not commend itself to his superiors in the Roman Church. In the days of St. Augustine or of St. Thomas Aquinas it would doubtless have been received much more kindly; but in the days of Cardinal Anto-

nelli this was hardly to be expected: the Roman authorities, seeing the danger of such plain revelations in the nineteenth century, even when coupled with such devout explanations, put the book under the ban, though not before it had been spread throughout the world in various translations. Father Huc was sent on no more missions.

Yet there came even more significant discoveries, especially bearing upon the claims of that great branch of the Church which supposes itself to possess a divine safeguard against error in belief. For now was brought to light by literary research the irrefragable evidence that the great Buddha—Sakya Muni himself—had been canonized and enrolled among the Christian saints whose intercession may be invoked, and in whose honor images, altars, and chapels may be erected; and this, not only by the usage of the mediæval Church, Greek and Roman, but by the special and infallible sanction of a long series of Popes, from the end of the sixteenth century to the end of the nineteenth—a sanction granted under one of the most curious errors in human history. The story throws an additional light upon the way in which many of the beliefs of Christendom have been developed, and especially upon the way in which they have been influenced from the seats of older religions.

Early in the seventh century there was composed, as is now believed, at the Convent of St. Saba near Jerusalem, a pious romance entitled Barlaam and Josaphat, the latter personage, the hero of the story, being represented as a Hindu prince converted to Christianity by the former.

This story, having been attributed to St. John of Damascus in the following century, became amazingly popular, and was soon accepted as true: it was translated from the Greek original not only into Latin, Hebrew, Arabic, and Ethiopic, but into every important European language, including even Polish, Bohemian, and Icelandic. Thence it came into the pious historical encyclopædia of Vincent of Beauvais, and, most important of all, into the Lives of the Saints.

Hence the name of its pious hero found its way into the list of saints whose intercession is to be prayed for and it passed without challenge until about 1590, when, the general subject of canonization having been brought up at Rome, Pope Sixtus V, by virtue of his infallibility and immunity against error in everything relating to faith and morals, sanctioned a revised list of saints, authorizing and directing it to be accepted by the Church; and among those on whom the seal of Heaven was thus forever infallibly set was included "The Holy Saint Josaphat of India, whose wonderful acts St. John of Damascus has related." The 27th of November was appointed as the day set apart in honor of this

saint, and the decree, having been enforced by successive popes for over two hundred and fifty years, was again officially approved by Pius IX in 1873. This decree was duly accepted as infallible, and in one of the largest cities of Italy may to-day be seen a Christian church dedicated to this saint. On its front are the initials of his Italianized name; over its main entrance is the inscription *Divo Josafat;* and within is an altar dedicated to the saint—above it being a pedestal bearing his name and supporting a large statue which represents him as a youthful prince wearing a crown and contemplating a crucifix.

Moreover, relics of the saints were found, and bones alleged to be parts of his skeleton having been presented by a Doge of Venice to a King of Portugal, are now treasured at Antwerp.

But even as early as the sixteenth century a pregnant fact regarding this whole legend was noted: for the Portuguese historian Diego Conto showed that it was identical with the legend of Buddha. Fortunately for the historian, his faith was so robust that he saw in this resemblance only a trick of Satan; the life of Buddha being, in his opinion, merely a diabolic counterfeit of the life of Josaphat centuries before the latter was lived or written—just as good Abbé Huc saw in the ceremonies of Buddhism a similar anticipatory counterfeit of Christian ritual.

There the whole matter virtually rested for about three hundred years—various scholars calling attention to the legend as a curiosity, but none really showing its true bearings, until, in 1859, Laboulaye in France, Liebrecht in Germany, and others following them in research, demonstrated that this Christian work was drawn almost literally from an early biography of Buddha, being conformed to it in the most minute details, not only of events but of phraseology; the only important changes being that, at the end of the various experiences showing the wretchedness of the world, identical with those ascribed in the original to the young Prince Buddha, the hero becomes a Christian, and that for the appellation of Buddha—"Bodesat"—is substituted the more scriptural name Josaphat.

Thus it was that by virtue of the infallibility vouchsafed to the papacy in matters of faith and morals Buddha became a Christian saint.

Yet these were by no means the most pregnant revelations. As the Buddhist scriptures were more fully examined, there were disclosed interesting anticipations of statements in later sacred books. The miraculous conception of Buddha and his virgin birth, like that of Horus in Egypt and of Krishna in India; the previous annunciation to his mother Maja; his birth during a journey by her; the star appearing in the east, and the angels chanting in the heavens at his birth; his temptation—all these

and a multitude of other statements were full of suggestions to larger thought regarding the development of sacred literature in general. Even the eminent Roman Catholic missionary, Bishop Bigandet, was obliged to confess in his scholarly life of Buddha these striking similarities between the Buddhist scriptures and those which it was his mission to expound, though by this honest statement his own further promotion was rendered impossible. Fausböll also found the story of the judgment of Solomon imbedded in Buddhist folklore; and Sir Edwin Arnold, by his poem, The Light of Asia, spread far and wide a knowledge of the anticipation in Buddhism of some ideas which, down to a recent period, were considered distinctively Christian. Imperfect as the revelations thus made of an evolution of religious beliefs, institutions, and literature still are, they have not been without an important bearing upon the newer conception of our own sacred books: more and more manifest has become the interdependence of all human development;* more and more clear the truth that Chris-

* For Huc and Gabet, see Souvenirs d'un Voyage dans la Tartarie, le Thibet, la Chine, English translation by Hazlitt, London, 1851; also supplementary work by Huc. For Bishop Bigandet, see his Life of Buddha, *passim*. As authority for the fact that his book was condemned at Rome and his own promotion prevented, the present writer has the bishop's own statement. For notices of similarities between Buddhist and Christian institutions, ritual, etc., see Rhys Davids's Buddhism, London, 1894, *passim*; also Lillie, Buddhism and Christianity—especially chaps. ii and xi. It is somewhat difficult to understand how a scholar so eminent as Mr. Rhys Davids should have allowed the Society for Promoting Christian Knowledge, which published his book, to eliminate all the interesting details regarding the birth of Buddha, and to give so fully everything that seemed to tell against the Roman Catholic Church; cf. p. 27 with p. 246 *et seq.* For more thorough presentation of the development of features in Buddhism and Brahmanism which anticipate those of Christianity, see Schroeder, Indiens Literatur und Cultur, Leipsic, 1887, especially Vorlesung xxvii and following. For full details of the canonization of Buddha under the name of St. Josaphat, see Fausböll, Buddhist Birth Stories, translated by Rhys Davids, London, 1880, pp. xxxvi and following; also Prof. Max Müller in the Contemporary Review for July, 1890; also the article Barlaam and Josaphat, in ninth edition of the Encyclopædia Britannica. For the more recent and full accounts, correcting some minor details in the foregoing authorities, see Kuhn, Barlaam und Joasaph, Munich, 1893, especially pp. 82, 83; also Zotenberg, cited by Gaston Paris in the Revue de Paris for June, 1895. For the transliteration between the appellation of Buddha and the name of the saint, see Fausböll and Sayce as above, p. xxxvii, note; and for the multitude of translations of the work ascribed to St. John of Damascus, see Table III on p. xcv. The reader who is curious to trace up a multitude of the myths and legends of early Hebrew and Christian mythology to their more eastern and southern sources can do so in Bible Myths, New York, 1883. The present writer gladly avails himself of the opportunity to thank the learned Director of the National Library at Palermo, Monsignor Marzo, for his kindness in showing him the very interesting church of San Giosafat in that city; and to the custodians of the church for their readiness to allow photographs of the saint to be taken. The writer's visit was made in April, 1895, and copies of the photographs may be seen in the library of Cornell University. As to the more rare editions of Barlaam and Josaphat, a copy of the Icelandic translation is to be seen in the remarkable collection of Prof. Willard Fiske, at Florence.

tianity, as a great fact in man's history, is not dependent for its life upon any parasitic growths of myth and legend, no matter how beautiful they may be.

No less important was the closer research into the New Testament during the latter part of the nineteenth century. This work has already been touched upon, but a few of the main truths which it brought before the world may be here summarized.

By the new race of Christian scholars it has been clearly shown that the first three Gospels, which, down to the close of the last century, were so constantly declared to be three independent testimonies agreeing as to the events recorded, are neither independent of each other nor in that sort of agreement which was formerly asserted. All biblical scholars of any standing, even the most conservative, have come to admit that all three took their rise in the same original sources, growing by the accretions sure to come as time went on—accretions sometimes useful and often beautiful, but in no inconsiderable degree ideas and even narratives inherited from older religions; it is also fully acknowledged that to this growth process are due certain contradictions which can not otherwise be explained. As to the fourth Gospel, exquisitely beautiful as large portions of it are, there has been growing steadily and irresistibly the conviction, even among the most devout scholars, that it represents an infusion of Greek conceptions into Hebraism, and that its final form is mainly due to some gifted representative or representatives of the Alexandrian school. Bitter as the resistance to this view has been, it has during the last years of the nineteenth century won its way more and more to acknowledgment. A careful examination made in 1893 by a competent Christian scholar showed facts which are best given in his own words, as follows: "In the period of thirty years ending in 1860, of the fifty great authorities in this line, *four to one* were in favor of the Johannine authorship. Of those who in that period had advocated this traditional position one quarter—and certainly the very greatest—finally changed their position to the side of a late date and non-Johannine authorship. Of those who have come into this field of scholarship since about 1860, some forty men of the first class, two thirds reject the traditional theory wholly or very largely. Of those who have contributed impor-

---

As to the influence of these translations, it may be noted that, when young John Kuncewicz, afterward a Polish archbishop, became a monk, he took the name of the sainted Prince Josafat; and, having fallen a victim to one of the innumerable murderous affrays of the seventeenth century between Greek and Roman Christians in Poland, he also was finally canonized under that name, evidently as a means of annoying the Russian Government. (See Contieri, Vita di S. Giosafat, Arcivescovo e Martira Ruteno, Roma, 1867.)

tant articles to the discussion from about 1880 to 1890, about *two to one* reject the Johannine authorship of the Gospel in its present shape; that is to say, while forty years ago great scholars were *four to one in favor of*, they are now *two to one against*, the claim that the apostle John wrote this gospel as we have it. Again, one half of those on the conservative side to-day—scholars like Weiss, Beyschlag, Sanday, and Reynolds—admit the existence of a dogmatic intent and an ideal element in this Gospel, so that we do not have Jesus's thought in his exact words, but only in substance."*

In 1881 came an event of great importance as regards the development of a more frank and open dealing with scriptural criticism. In that year appeared the Revised Version of the New Testament. It was exceedingly cautious and conservative; but it had the vast merit of being absolutely conscientious. One thing showed, in a striking way, ethical progress in theological methods. Although all but one of the English revisers represented Trinitarian bodies, they rejected the two great proof texts which had so long been accounted essential bulwarks of Trinitarian doctrine. Thus disappeared at last from the Epistle of St. John the text of the Three Witnesses, which had for centuries held its place in spite of its absence from all the earlier important manuscripts, and of its rejection in later times by Erasmus, Luther, Isaac Newton, Porson, and a long line of the greatest biblical scholars. And with this was thrown out the other like unto it in spurious origin and zealous intent, that interpolation of the word "God" in the sixteenth verse of the third chapter of the First Epistle to Timothy which had for ages served as a warrant for condemning some of the noblest of Christians, even such men as Newton and Milton and Locke and Priestley and Channing.

Indeed, so honest were the revisers that they substituted the correct reading of Luke, ii, 33, in place of the time-honored corruption in the King James version which had been thought necessary to safeguard the dogma of the virgin birth of Jesus of Nazareth. Thus came the true reading, "*His father* and his mother," instead of the old piously fraudulent words "*Joseph* and his mother."

An even more important service to the new and better growth of Christianity was the virtual setting aside of the last twelve

---

* For the citations given regarding the development of thought in relation to the fourth Gospel, see Crooker, The New Bible and its Uses, Boston, 1893, pp. 29, 30. For a very careful and candid summary of the reasons which are gradually leading the more eminent among the newer scholars to give up the Johannine authorship of the fourth Gospel, see Schürer, in the Contemporary Review for September, 1891.

verses of the Gospel according to St. Mark. For among these stood that sentence which has cost the world more innocent blood than any other—the words "He that believeth not shall be damned." From this source had logically grown the idea that the intellectual rejection of this or that dogma which dominant opinion had happened at any given time to pronounce essential, since such rejection must bring punishment infinite in agony and duration, is a crime to be prevented at any cost of finite cruelty. Still another service rendered to humanity by the revisers was in substituting a new and correct rendering for the old reading of the famous text regarding the inspiration of Scripture, which had for ages done so much to make our sacred books a fetich. By this more correct reading the revisers gave a new charter to liberty in biblical research.*

Most valuable, too, have been studies during the latter part of the nineteenth century upon the formation of the canon of Scripture. The result of these has been to substitute something far better for that conception of our biblical literature, as forming one book handed out of the clouds by the Almighty, which had been so long practically the accepted view among probably the majority of Christians. Reverent scholars have demonstrated our sacred literature to be a growth in obedience to simple laws natural and historical; they have shown how some books of the Old Testament were accepted as sacred, centuries before our era, and how others gradually gained sanctity, in some cases only acquiring it long after the establishment of the Christian Church. The same slow growth has also been shown in the New-Testament canon. It has been demonstrated that the selection of the books composing it was a gradual process, and indeed that the rejection

---

* The texts referred to as most beneficially changed by the revisers, are I John, v, 7; I Timothy, iii, 16.

Though the revisers thought it better not to suppress altogether the last twelve verses of St. Mark's Gospel, they softened the word "damned" to "condemned," and separated them from the main Gospel, adding a note stating that "the two oldest Greek manuscripts, and some other authorities, omit from verse nine to the end"; and that "some other authorities have a different ending to this Gospel."

The resistance of staunch high churchmen of the older type even to so mild a reform as the first change above noted may be exemplified by a story told of Philpotts, Bishop of Exeter, about the middle of the nineteenth century. A kindly clergyman reading the invitation to the holy communion, and thinking that so affectionate a call was disfigured by the harsh phrase "eateth and drinketh to his own damnation," ventured timidly to substitute the word "condemnation." Thereupon the bishop, who was kneeling with the rest of the congregation, threw up his head and roared "*damnation!*" The story is given in T. A. Trollope's What I Remember, vol. i, p. 444. American churchmen may well rejoice that the fathers of the American branch of the Anglican Church were wise enough and Christian enough to omit from their prayer book this damnatory clause, as well as the Commination Service and the Athanasian Creed.

of some books and the acceptance of others was accidental, if anything is accidental.

So, too, scientific biblical research has, as we have seen, been obliged to admit the existence of much mythical and legendary matter, as a setting for the great truths, not only of the Old Testament but of the New. It has also shown, by the comparative study of literatures, the process by which some books were compiled and recompiled, adorned with beautiful utterances, strengthened or weakened by interpolations expressing the views of the possessors or transcribers, and assigned to personages who could not possibly have written them. The showing forth of these things has greatly weakened that sway of mere dogma which has so obscured the simple teachings of Christ himself; for it has shown that the more we know of our sacred books, the less certain we become as to the authenticity of proof texts, and it has disengaged more and more, as the only valuable residuum, like the mass of gold at the bottom of the crucible, the personality and general teaching and ideals of the blessed Founder of Christianity. More and more, too, the new scholarship has developed the conception of the New Testament as, like the Old, the growth of literature in obedience to a divine law—a conception which in all probability will give it its strongest hold on the coming centuries. In making this revelation Christian scholarship has by no means done work mainly destructive. It has, indeed, swept away a mass of noxious growths, but it has at the same time cleared the ground for a better growth of Christianity—a growth through which already pulsates the current of a nobler life. It has forever destroyed the contention of scholars like those of the eighteenth century, who saw, in the multitude of irreconcilable discrepancies between various biblical statements, merely evidences of priestcraft and intentional fraud. The new scholarship has shown that even such absolute contradictions as that between the date assigned for the crucifixion in the first three Gospels and that given in the fourth, and other discrepancies hardly less serious, do not affect the historical character of the essential part of the narrative. Even the hopelessly conflicting genealogies of the Saviour and the evidently mythical accretions about the simple facts of his birth and life are thus full of interest when taken as a natural literary development.*

* Among the newer English works on the canon of Scripture, especially as regards the Old Testament, see Ryle in work cited. As to the evidences of frequent mutilations of the New Testament text, as well as of frequent charge of changing texts made against each other by early Christian writers, see Reuss, History of the New Testament, vol. ii, § 362. For a reverent and honest treatment of some of the discrepancies and contradictions which are absolutely irreconcilable, see Crooker, as above; also Matthew Arnold, Literature and Dogma.

Among those who have wrought most effectively to bring the leaders of thought in the English-speaking nations to this higher conception, Matthew Arnold should not be forgotten. By poetic insight, broad scholarship, pungent statement, pithy argument, and an exquisitely lucid style, he aided effectually during the latter half of the nineteenth century in bringing the work of specialists to bear upon the general development of a broader and deeper view. In the light of his genius a conception of our sacred books at the same time more literary as well as more scientific has grown widely and vigorously, while the older view which made of them a fetich and support for unchristian dogmas has been more and more thrown into the background. The contributions to these results by the most eminent professors at the great Christian universities of the English-speaking world, Oxford and Cambridge taking the lead, are most hopeful signs of a new epoch. Very significant, also, is a change in the style of argument against the scientific view. Leading supporters of the older opinions see more and more clearly the worthlessness of rhetoric against ascertained fact: mere dogged resistance to cogent argument evidently avails less and less, and the readiness of the more prominent representatives of the older thought to consider opposing arguments, and to acknowledge any force they may have, is certainly of good omen. The concessions made in Lux Mundi regarding scriptural myths and legends have been already mentioned.

Typical, also, among the evidences of a better spirit in controversy has been the treatment of the question regarding mistaken quotations from the Old Testament in the New, and especially regarding quotations by Christ himself. For a time this was apparently the most difficult of all matters dividing the two forces; but, though here and there appear champions of tradition, like the Bishop of Gloucester, effectual resistance to the new view has virtually ceased; in one way or another the most conservative authorities have accepted the undoubted truth revealed by a simple scientific method. Their arguments have indeed been varied. While some have fallen back upon Le Clerc's contention that "Christ did not come to teach criticism to the Jews," and others upon Paley's argument that the Master shaped his statements in accordance with the ideas of his time, others have taken refuge in scholastic statements—among them that of Irenæus regarding "a quiescence of the divine word," or the somewhat startling explanation by sundry recent theologians that "our Lord emptied himself of his Godhead."*

* For Matthew Arnold, see especially his Literature and Dogma and his St. Paul and Protestantism. As to the quotations in the New Testament from the Old, see Toy, Quota-

But for all this dissolving away of the traditional opinions regarding our sacred literature, there has been a cause far more general and powerful than any which has been given, for it is a cause surrounding and permeating all. This is simply the atmosphere of thought engendered by the development of all sciences during the last three centuries.

Vast masses of myth, legend, marvel, and dogmatic assertion, coming into this atmosphere, have been dissolved and are now dissolving quietly away like icebergs drifted into the Gulf Stream. In earlier days, when some critic in advance of his time insisted that Moses could not have written an account embracing the circumstances of his own death, it was sufficient to answer that Moses was a prophet; if attention was called to the fact that the great early prophets, by all which they did and did not do, showed that there could not have existed in their time any "Levitical code," a sufficient answer was "mystery"; and if the discrepancy was noted between the two accounts of creation in Genesis, or between the genealogies or the dates of the crucifixion in the Gospels, the cogent reply was "infidelity." But the thinking world has at last been borne by the general development of a scientific atmosphere beyond that kind of refutation.

If, in the atmosphere generated by the earlier developed sciences, the older growths of biblical interpretation have drooped and withered and are evidently perishing, new and better growths with roots running down into the newer sciences have arisen. Comparative mythology and folklore, comparative religion and literature, by searching out and laying side by side the main facts in the upward struggle of humanity in various old seats of civilization, are giving a new interpretation of these great problems which dogmatic theology has long labored in vain to solve. Thus, while they have established the fact that accounts formerly supposed to be special revelations to Jews and Christians are but repetitions of widespread legends dating from far earlier civilizations, and that beliefs formerly thought fundamental to Judaism and Christianity are simply based on ancient myths, they have also begun to impress upon the intellect and conscience of the thinking world the fact that the

---

tions in the New Testament, 1889, p. 72; also Kuenen, The Prophets and Prophecy in Israel. For Le Clerc's mode of dealing with the argument regarding quotations from the Old Testament in the New, see earlier parts of the present chapter. For Paley's mode, see his Evidences, Part III, chapter iii. For the more scholastic expressions from Irenæus and others, see Gore, Bampton Lectures, 1891, especially note on p. 267. For a striking passage on the general subject, see B. W. Bacon, Genesis of Genesis, p. 33, ending with the words, "We must decline to stake the authority of Jesus Christ on a question of literary criticism."

religious and moral truths thus disengaged from the old masses of myth and legend are all the more beautiful and serviceable, and that all individual or national life of any value must be vitalized by them.*

Nor should there be omitted a tribute to the increasing justice and courtesy shown in late years by leading supporters of the older view. During the last two decades of the present century there has been a most happy departure from the older method of resistance, first by plausibilities, next by epithets, and finally by persecution. To the bitterness of the attacks upon Darwin, the Essayists and Reviewers, and Bishop Colenso, have succeeded, among really eminent leaders, a far better method and tone. While Matthew Arnold, no doubt, did much in commending "sweet reasonableness" to theological controversialists, Mr. Gladstone, by his perfect courtesy to his opponents, even when smarting under their heaviest blows, has set a most valuable example. Nor should the spirit shown by Bishop Ellicott, leading a forlorn hope for the traditional view, pass without a tribute of respect. Truly pathetic is it to see this venerable and learned prelate, one of the most eminent representatives of the older biblical research, even when giving solemn warnings against the newer criticisms, and under all the temptations of *ex cathedra* utterance, remaining mild and gentle and just in the treatment of adversaries whose ideas he evidently abhors. Happily, he is comforted by the faith that Christianity will survive; and this faith his opponents fully share.†

Thus at last, out of the old conception of our Bible as a collection of oracles—a mass of entangling utterances, fruitful in wrangling interpretations, which have given to the world long and weary ages of "hatred, malice, and all uncharitableness," of fetichism, subtlety, and pomp, of tyranny, bloodshed, and solemnly constituted imposture, of everything which the Lord Jesus Christ most abhorred—has been gradually developed through the centuries, by the labors, sacrifices, and even the martyrdom of a long succession of men of God, the conception of it as a sacred literature, a growth in obedience to divine light in the mind and heart and soul of man. No longer an oracle, good for the "lower

---

* For plaintive lamentations over the influence of this atmosphere of scientific thought upon the most eminent contemporary Christian scholars, see the Christus Comprobator, by the Bishop of Gloucester and Bristol, London, 1893, and the article in the Contemporary Review for May, 1892, by the Bishop of Colchester, *passim*. For some less known examples of sacred myths and legends, inherited from ancient civilizations, see Lenormant, Les Origines de l'Histoire, *passim*, but especially chapters ii, iv, v, vi. See also Goldziher.

† As examples of courtesy between theologic opponents may be cited the controversy between Mr. Gladstone and Prof. Huxley, Principal Gore's Bampton Lectures for 1891, and Bishop Ellicott's Charges, published in 1893.

orders" to accept, but to be quietly sneered at by "the enlightened"—no longer a fetich, whose defenders must become persecutors or "apologists," but a most fruitful fact, which religion and science may accept as a source of strength to both.*

PROFESSIONAL INSTITUTIONS.

VI.—MAN OF SCIENCE AND PHILOSOPHER.

By HERBERT SPENCER.

CLEAR as are the connections between the priesthood and the several professions thus far treated of, the connection between it and the professions which have enlightenment as their function is even clearer. Antagonistic as the offspring now are to the parent they were originally nurtured by it.

We saw that the medicine-man, ever striving to maintain and increase his influence over those around, is stimulated more than others to obtain such knowledge of natural phenomena as may aid him in his efforts.

Moreover, when seeking to propitiate the supernatural beings he believes in, he is led to think about their characters and their doings. He speculates as to the causes of the striking things he observes in the Heavens and on the Earth; and whether he regards these causes as personal or impersonal, the subject-matter of his thought is the subject-matter which, in later times, is distinguished as philosophical—the relations between that which we perceive and that which lies beyond perception.

As was said at the outset, a further reason why he becomes distinguished from men around by his wider information and deeper insight is that he is, as compared with them, a man of leisure. From the beginning he lives on the contributions of others; and therefore he is better able to devote himself to those observations and inquiries out of which science originates.

Save some knowledge of medicinal herbs and special animal

* To the fact that the suppression of personal convictions among "the enlightened" did not cease with the Medicean Popes there are many testimonies. One especially curious was mentioned to the present writer by a most honored diplomatist and scholar at Rome. While this gentleman was looking over the books of an eminent cardinal, recently deceased, he noticed a series of octavos bearing on their backs the title Acta Apostolorum. Surprised at such an extension of the Acts of the Apostles, he opened a volume and found the series to be the works of Voltaire. As to a similar condition of things in the Church of England may be cited the following from Froude's Erasmus: "I knew various persons of high reputation a few years ago who thought at bottom very much as Bishop Colenso thought, who, nevertheless, turned and rent him to clear their own reputations—which they did not succeed in doing." See work cited, close of Lecture XI.

products, with perhaps a little information about minerals, often joined with such observations of weather-signs as enables them to foresee coming changes, and so, apparently, to bring rain or sunshine, there is little to be named as rudimentary science among the medicine-men, or quasi-priests, of savages. Only when there has arisen that settled life which yields facilities for investigation and for transmitting the knowledge gained, can we expect priests to display a character approaching to the scientific. Hence we may pass at once to early civilizations.

Evidence from the books of Ancient India may first be set down. Demonstration is yielded by it that science was originally a part of religion. Both astronomy and medicine, says Weber, "received their first impulse from the exigencies of religious worship." More specific, as well as wider, is the following statement of Dr. Thibaut:—

"The want of some rule by which to fix the right time for the sacrifices gave the first impulse to astronomical observations; urged by this want the priest remained watching night after night the advance of the moon. . . . and day after day the alternate progress of the sun toward the north and the south. The laws of phonetics were investigated because the wrath of the gods followed the wrong pronunciation of a single letter of the sacrificial formulas; grammar and etymology had the task of securing the right understanding of the holy texts."

Further, according to Dutt, "geometry was developed in India from the rules for the construction of altars." A sentence from the same writer implies that there presently arose a differentiation of the learned class from the ceremonial class.

"Astronomy had now come to be regarded as a distinct science, and astronomers by profession were called Nakshatra, Darsa, and Ganaka . . . sacrificial rites were regulated by the position of the moon in reference to these lunar asterisms."

So, too, we have proof that philosophy, originally forming a part of the indefinite body of knowledge possessed by the priesthood, eventually developed independently. Hunter writes:—

"The Bráhmans, therefore, treated philosophy as a branch of religion. . . . Bráhman philosophy exhausted the possible solutions . . . of most of the other great problems which have since perplexed Greek and Roman sage, mediæval schoolman, and modern man of science."

And in this, as in other cases, the speculative and critical activity presently led to rationalism. There came "a time when philosophers and laymen were alike drifting toward agnostic and heterodox opinions."

Concerning the relations of science to theology among the Babylonians and Assyrians, current statements almost suffice for the purpose of the argument. A few facts in illustration must, however, be given. All the astronomical knowledge of the Babylonians had as its ends the regulation of religious worship, the

preparation of charms, the prediction of events. Here are extracts from Rawlinson, Layard, and Maury showing how religion and science were mingled.

"We are, perhaps, justified in concluding, from the careful emplacement of Urukh's temples, that the science of astronomy was already cultivated in his reign, and was regarded as having a certain connection with religion."

"At a very early period the Assyrian priests were able to fix the date of events by celestial phenomena, and to connect the public records with them."

The familiar fact that the cycle of lunar eclipses was discovered by the Chaldean priests, shows how exact and how long-continued were their observations.

"Comparative philology seems to have been largely studied, and the works upon it exhibit great care and diligence. Chronology is evidently much valued, and very exact records are kept whereby the lapse of time can even now be accurately measured. Geography and history have each an important place in Assyrian learning; while astronomy and mythology occupy at least as great a share of attention."

Les Chaldéens avaient "une caste sacerdotale et savante qui se consacra à l'observation du ciel, en vue de pénétrer davantage dans la connaissance des dieux. . . . De la sorte, les temples devinrent de véritables observatoires: telle était la célèbre tour de Babylone, monument consacré aux sept planètes."

Of testimonies concerning science in Egypt, we may fitly begin with one from Maspero, which contrasts Egyptian views with the views of the Assyrians.

"In Egypt the majority of the books relating to science are sacred works composed and revealed by the gods themselves. The Assyrians do not attribute such a lofty origin to the works which teach them the courses and explain the influences of the stars: they believe them to have been written by learned men, who lived at different epochs, and who acquired their knowledge from direct observation of the heavens."

Basing his account on the statements of various ancient writers, Sir G. C. Lewis says of the Egyptian priesthood that—

"they were relieved from toil, and had leisure for scientific study and meditation; and that from a remote period they habitually observed the stars, recorded their observations, and cultivated scientific astronomy and geometry. The Egyptian priests are moreover related to have kept registers, in which they entered notices of remarkable natural phenomena." (Strab. xvii, 1. § 5.)

Similar is the description of the actions and achievements of the Egyptian priests given by Diodorus:—

They "are diligent observers of the course and motions of the stars; and preserve remarks of every one of them for an incredible number of years, being used to this study, and to endeavor to outvie one another therein, from the most ancient times. They have with great cost and care, observed the motions of the planets; their periodical motions, and their stated stops."

How intimate was the connection between their science and their religion is proved by the fact that "in every temple there was . . . an astronomer who had to observe the heavens;" and how their science was an outgrowth of their religion is shown by the remark of Duncker, that their writings, at first containing traditional invocations of the gods and ceremonial rules, "grew into a liturgical canon and ecclesiastical codex of religious and moral law, and a comprehensive collection of all the wisdom known to the priests." But, as is remarked by Bunsen, "the Egyptians never arrived at a systematic dialectically-conducted philosophy" —a fact of much significance; for I may remark in passing that among oriental peoples at large, and other peoples long habituated to despotic control, thinking and teaching are entirely dogmatic: absolute authority characterizes at once external government and internal government. It is only on passing to partially-free societies that we meet with appeals to individual judgments —a giving of reasons for beliefs.

Apparently because Greece was a congeries of independent states often at variance with one another, and because these states had their respective religious worships akin but not identical, there never arose in Greece a priestly hierarchy; and apparently the lack of one impeded some of the professional developments. Partly, perhaps, for this reason, but chiefly for the reason that scientific progress in Egypt and Assyria preceded Greek civilization, science in as lightly developed state was imported. Sir G. C. Lewis repeats the testimonies of sundry ancient authors to the effect that the Egyptian priests—

"regarded their astronomical science as an esoteric and mysterious doctrine, and that they disclosed it to curious strangers with reluctance (Strab. xvii, 1. § 29). . . . Similar statements are made with respect to Assyrian astronomy (Plat. Epinom. § 7, p. 987). This derivation does not rest merely on general declarations, but it is fortified by detailed accounts of visits of Greek philosophers to Egypt, to Assyria, and to other oriental countries, made for the purpose of profiting by the lessons of the native priests and sages." Thus Thales, Pherecydes of Syros, Pythagoras, Democritus, Œnopides of Chios, Eudoxus, Solon, Anaxagoras, Plato are said to have visited Egypt, and to have received instruction from the priests.

And from his work may be added this further passage:—"Aristotle . . . says that mathematical science originated in Egypt, on account of the leisure which the priests enjoyed for contemplation." Respecting which statement may be interposed the remark that whether the name "geometry" was a translation of the Egyptian equivalent word or was independently originated, we equally see, in the first place, that this concrete half of mathematics germinated from the practical needs for measuring out the Earth's surface, and we see, in the second place, that since

temples (which served also as king's palaces) were in early times the sole permanent and finished buildings (the rest being of wood or of sun-dried clay) it is inferable that this great division of science, first employed in the orientation and laying out of them, took its earliest steps in the service of religion. Returning now from this parenthesis to the subject of Greek science, we find that development of it can be but in very small measure ascribed to the priesthood. From Curtius we learn that "the localities of the oracles became places where knowledge of various kinds was collected, such as could not be met with elsewhere," and that "the Greek calendar fell under the superintendence of Delphi," and also that "the art of road-making and of building bridges took its first origin from the national sanctuaries, especially from those of Apollo:" some culture of science being thus implied. But, practically, the scientific advances made by the Greeks were not of sacred but of secular origin. So, too, was it with their philosophy. Though Mahaffy thinks "we have no reason to doubt the fact that philosophers were called in professionally to minister in cases of grief," and though in ministering they assumed a function characteristic of priests, yet we can not assume that they acted in a religious capacity. Evidently in the main their speculations took their departure not from theological dogmas but from the facts which scientific observation had elsewhere established. Before there was time for an indigenous development of science and philosophy out of priestly culture, there was an intrusion of that science and philosophy which priestly culture had developed elsewhere.

The normal course of evolution having been in Rome, still more than in Greece, interrupted by intruding elements, an unbroken genealogy of science and philosophy is still less to be looked for. But it seems as though the naturalness of the connection between priestly culture and scientific knowledge led to a re-genesis of it. Mommsen, after stating that there were originally only two "colleges of sacred lore"—the augurs and the pontifices, says:—

"The five 'bridge-builders' (pontifices) derived their name from their function, as sacred as it was politically important, of conducting the building and demolition of the bridge over the Tiber. They were the Roman engineers who understood the mystery of measures and numbers; whence there devolved upon them also the duties of managing the Calendar of the State, of proclaiming to the people the time of the new and full moon and the days of festivals, and of seeing that every religious and every judicial act took place on the right day . . . thus they acquired . . . the general oversight of Roman worship and of whatever was connected with it—and what was there that was not so connected? . . . In fact the rudiments of spiritual and temporal jurisprudence as well as of historical composition proceeded from this college."

A curious parallel, not unsuggestive, is thus displayed. As in Greece the art of bridge-building arose in connection with the national sanctuaries, and as in Rome the building of bridges was the function of a priestly college, the implication appears to be that since in those days building a bridge was one of the most difficult of undertakings, it naturally fell into the hands of those who were reputed to have the greatest knowledge and skill—the priests. And, probably, the connection between the priesthood and this piece of applied science was furthered by the apparent supernaturalness of the arch—a structure which must have seemed to the people incomprehensible. But alike in science and in philosophy, the Romans were the pupils of the Greeks; and hence possibly may have arisen the parallelism between a certain function of the philosopher in Greece and one he exercised in Rome.

The philosopher "was generally to be found in a large mansion acting almost like a private chaplain, instructing in ethics those who wished to learn, and attending the death-beds of members of the family."

Most likely, the ethics and the consolations here indicated were more or less tinged with ideas theologically derived; but even if not, the function described appears semi-priestly.

During those dark days which followed the fall of the Roman Empire, nothing to be called science existed. But when, along with gradual reorganization, the re-genesis of science began, it began as in earlier instances among the cultured men—the priesthood. It was not, indeed, a re-genesis *de novo*, but one which took its departure from the knowledge, the ideas, and the methods, bequeathed by the older civilizations. From these, long buried, it was resuscitated, almost exclusively in the monasteries. In his *Science and Literature in the Middle Ages* Lacroix writes:—

"At the death of Charlemagne, the exact sciences, which had flourished for a brief space at his court, seemed to shrink into the seclusion of the monasteries. . . . The order of St. Benedict had almost made a monopoly of the exact sciences, which were held in high honor at the Abbeys of Mount Cassini, in Italy; of St. Martin, at Tours (France); of St. Arnulph, at Metz; of St. Gall, in Switzerland; of Prum, in Bavaria; of Canterbury, in England, etc."

A significant parallelism has here to be noted. We saw that in India, in Assyria, and in Egypt, the earliest steps in science were made in subservience to religious needs: their primary purpose was to regulate the times of religious sacrifices so as to avoid offense to the gods. And now, strange to say, mediæval records show that among Christian peoples science was first called in for fixing the date of Easter.

How on the Continent was illustrated the monopoly of science

and philosophy by the priesthood in early days, scarcely needs pointing out. Such philosophical dogmas as were current during the ages of darkness were supplementary to the current theological dogmas and in subordination to them. When, in the time of Charlemagne, some intellectual life began, it was initiated by the establishment of schools in connection with all abbeys throughout his dominions. These schools, carried on under priestly rule, eventually became the centers at once of philosophy and science: the philosophy distinguished as scholasticism being of such kind as consisted with the authorized theology, and the science—geometry, arithmetic, astronomy, and music—being such as did not obviously conflict with it or could be conformed to it. That is to say, alike in their nature and in their agency, the philosophy and science of the time diverged in a relatively small degree from the theology—the differentiation was but incipient. And the long continued identification of the cultivators of philosophy and science with the cultivators of theology is seen in the familiar names of the leading scholastics—William of Champeaux, Abelard, Albertus Magnus, Thomas Aquinas, etc. To which may be added the notable fact that such independence of theological dogma as was thought to be implied in the doctrine of the Nominalists, was condemned alike by the Pope and by secondary ecclesiastical authorities—the differentiation was slowly effected under resistance.

In England there was a no less clear identity of the priest with the philosopher and the man of science. In his account of the Saxon clergy Kemble writes:—

> "They were honorably distinguished by the possession of arts and learning, which could be found in no other class. . . . To them England owed the more accurate calculations which enabled the divisions of times and seasons to be duly settled."

The first illustration is furnished by Bede, a monk who, besides works of other kinds, wrote a work on *The Nature of Things*, in which the scientific knowledge of his day was gathered up. Next may be named Dicuil, an Irish monk and writer on geography. And then comes Archbishop Dunstan:—

> He "was very well skilled in most of the liberal arts, and among the rest in refining metals and forging them; which being qualifications much above the genius of the age he lived in, first gained him the name of a conjurer, and then of a saint."

Though, soon after the Conquest, there lived two cultivators of science who seem not to have been clerical—Gerland and Athelard of Bath—yet it is to be remarked of the first that his science was devoted to a religious purpose—making a *Computus* or calculation of Easter,—and of the other that his scientific knowledge was acquired during travels in the East, and can not be regarded as

an indigenous development. In Richard the First's time flourished Abbot Neckham, who wrote a scientific treatise in Latin verse, and the Bishop-elect Giraldus Cambrensis, who was a topographer. Under John we have Bishop Grosseteste, a writer on physical science, and in the next reign comes the Franciscan monk Roger Bacon, whose scientific reputation is familiar. The 15th century yields us among clerical men of science John Lydgate, chiefly known for his poetry. When we turn back to see who were the first to occupy themselves with the science of the sciences—philosophy—we perceive this same connection. In the old English period lived Scotus Erigena, a philosophical ecclesiastic whose philosophy was theological in its bearings. After a long interval, the next of this class was prior Henry of Huntingdon, who, as a moralist, brought other incentives than divine commands to bear on conduct. Presently came Bishop John of Salisbury, who, besides being classed as a writer on morality, was more distinctly to be classed as a writer on ancient philosophy. Grosseteste to his physical philosophy added mental philosophy, as also did Roger Bacon.

Joined with the fact that in mediæval days scarcely any laymen are named as devoted to studies of these kinds, the facts above given suffice to show that in Christian Europe, as in the pagan East, the man of science and the philosopher were of priestly origin. Inductive proof seems needless when we remember that during pre-feudal and feudal days, war and the chase were thought by the ruling classes the only honorable occupations. Themselves unable to read and write, they held that learning should be left to the children of mean people. And since learning was inaccessible to the masses, it becomes a necessary implication that the clerical class was the one to which mental culture of all kinds, inclusive of the scientific and philosophical kinds, was limited.

To trace the stages by which has been gradually effected the differentiation of the scientifico-philosophical class from the clerical class is not here requisite. It will suffice to note the leading characters of the change, and the state now reached.

The first broad fact to be observed is that the great body of doctrine distinguished by being based on reason instead of authority, has divided into a concrete part and an abstract part; with the result of generating two different classes of cultivators —the man of science and the philosopher. In the ancient East the distinction between the two was vague. Among the Greeks, from Thales onward, the thinker was one who studied physical facts and drew his general conceptions from them. Even on coming to Aristotle we see in the same man the union of

scientific inquiry and philosophical speculation. So all through the development of knowledge in Europe, down to the time of Newton, when the use of the term "natural philosophy" for physical science implies an indefinite distinction between the two. But now the distinction has become tolerably definite—quite definite in Germany and in large measure definite here. The philosopher does not enter upon scientific investigations and often knows little about scientific truths; while, conversely, the man of science, of whatever class, is little given to philosophical speculation, and is commonly uninformed about the philosophical conclusions held by this or that school. How distinct the two classes have become is implied by the contempt not unfrequently expressed by each for the other.

Simultaneously there has progressed a separation within the body of scientific men into those who respectively deal with the inorganic and the organic. Nowadays, men who occupy themselves with mathematical, physical and chemical investigations are generally ignorant of biology; while men who spend their lives in studying the phenomena of life, under one or other of its aspects, are often without interest in the truths constituting the exact sciences. Between animate and inanimate things there is a marked contrast, and there has come to be a marked division between the students of the two groups.

Yet a further transformation of the same nature has been going on. Within each of these groups differentiations and sub-differentiations have been taking place. The biologists have divided themselves primarily into those who study plant-life and those who study animal-life—the phytologists (commonly called botanists) and the zoölogists. In each of these great divisions there have been established large sub-divisions: in the one those who devote themselves to the classification of species, those who treat of plant-morphology, those who treat of plant-physiology; and in the other the classifiers, the comparative anatomists, the animal-physiologists. More restricted specializations have arisen. Among botanists there are some who study almost exclusively this or that order; among physiologists, some who commonly take one class of function for their province, and among zoölogists there are first of all the divisions into those who are professed entomologists, ornithologists, ichthyologists, etc., and again within each of these are smaller groups, as among the entomologists, those who study more especially the coleoptera, the lepidoptera, the hymenoptera, etc.

Respecting these major and minor differentiations it has only further to be remarked that though the prosecution of science as a whole is not called a profession (the whole being too extensive and heterogeneous), yet the prosecution of this or that part of it

has come to be thus distinguished. We have "professors" of various divisions and sub-divisions of it; and this implies that the bread-winning pursuit of science, irrespective of the particular kind, must be regarded as a profession.

The combinations of like units which have accompanied these separations of unlike units, are equally conspicuous. Those occupied in science as a whole, as well as those occupied in particular divisions of science, have everywhere tended to segregate themselves and consolidate.

On the Continent each nation has a scientific academy or equivalent body, and in some cases several such. In our own country we have, similarly, a fixed general union among scientific men—the Royal Society; in addition to which we have a nomadic general union—the British Association.

Then beyond these largest corporations including all kinds of scientific men, we have various smaller corporations, each comprised of those devoted to a particular branch or sub-branch of science—a Mathematical Society, a Physical Society, a Chemical Society, an Astronomical Society, a Geological Society, a Physiological Society; and others occupied with sub-divisions of Biology —Botany, Zoölogy, Anthropology, and Entomology: all of them being children of the Royal Society and in some measure aids to it. Nor let us forget that besides these metropolitan societies there are scattered throughout the kingdom local societies, devoted to science in general or to some division of science.

This is not all. Integration, general and special, of the scientific world is made closer, and the co-operation of all parts aided, by continuous publications: weekly and monthly and quarterly journals which are general in their scope, and others of like periodicities which are special in their scope. Thus minor aggregates held in connection as parts of a great aggregate have their activities furthered by literary inter-communication; and as elsewhere implied (see *Essays*, vol. i, "The Genesis of Science"), the vast organism thus constituted has acquired a power of digesting and assimilating the various classes of phenomena which no one part of it alone could effectually deal with.

How the style of house-building may be affected by the character of the neighborhood is illustrated by the observation of Captain H. Bowen, that while traveling in Turkistan, after crossing the Kotli-i Kandahar Pass, from the Tung River into the valley of the Wachi River, the houses bore evidence of the fear in which the inhabitants live of their neighbors on the south, the Kunjuts. Instead of scattered farmhouses, the traveler invariably found several houses joined together and presenting a fortlike appearance.

TROUT CULTURE.

By FRED MATHER.

IN the early days of fish culture, which for many years was only trout culture, the statement was often made that any farmer who had a small spring of cool water could, within a few years, realize enormous profits from it, and that an acre of water was worth more than an acre of land. Those of us who went into the business a quarter of a century ago found much to learn, and many dropped out discouraged. The writer bought a farm in Monroe County, New York, in 1868, and made ponds below a fine spring; and after some failures, due to ignorance—for there was then no literature of the subject—he began to succeed in raising many fish, only to find, after raising them, that they had cost more than they were worth, because there was no available food near, and it required a man to drive fourteen miles to the city of Rochester twice or more per week for food. To-day we know that something more than a good spring of cool water of about 50° F. is necessary, and also that some acres of water may be worth more than some land, but that so many local and other conditions enter into the calculation that, as a general statement, the comparison is not true. To-day there are several successful trout farms where the fish are raised for market at a profit, and in all of them there are large, never-failing springs of cool water and cheap food, as well as intelligent management. There are other important considerations in choosing the location of a trout farm, such as a proper amount of fall to the water in order to control it and give it aëration between the ponds and a formation that will allow all surface water to be led aside and not to enter the ponds. A sudden thaw with frozen ground may destroy the work of years, and in summer the surface water brings leaves and trash, which clog screens and either burst or overflow them.

The first thing to be considered is whether the trout farmer wishes to merely hatch his fish and turn them into a suitable lake or pond where they will find their own food and where he can take a few for sport and market, and perhaps let anglers fish it for a fixed sum, or whether he prefers to raise his fish by hand in small pools.

The first method is the simplest, involving the least care, but, if the conditions are favorable, not so profitable as the other. One is like keeping a few fowls that pick up what they can, and the other like poultry breeding, with this exception: poultry will not eat their young, while trout will devour their fellows which are smaller. A trout under a year old feeds mainly on insects and their larvæ in a state of nature, but a large trout of two

pounds weight prefers something more substantial, like a yearling trout or two for breakfast and a few more at intervals, with flies and worms for dessert; and this cannibalism is what keeps the balance of life in a natural state. If, however, it is decided to follow the first-named system, it will only be necessary to provide spawning races for the adults and follow the rules for hatching the eggs, and either turn out the product as fry or as yearlings; the latter will give the best results where transportation is not needed, as in the work of the fish commissions of the different States.

STRIPPING A SMALL TROUT.

Where it is desired to make a business of trout-raising a series of small ponds are necessary. After leaving the springs the water, in summer, is continually approaching the temperature of the air; and when it gets to 70° the danger line is reached. In swift water our brook trout have lived at five degrees above that point, but they suffered, and some have died, while others lived until the declining sun permitted the water to cool a trifle. This is a point that should be in mind when planning ponds, for it is of the greatest importance. A spring brook that will sustain many trout in a pond of half an acre might fail to keep a single one if the area was doubled. The surface and the shallows are warmer in summer than the deeper portions, and in the case of springs in the bottom of lakes or ponds the trout will gather about them in warm weather. In the pond system the ponds are so small that the fish can be seen at all times and their growth noted, so that those which have outstripped their fellows may be taken out and placed with others of the same size. This is practiced once a year with the larger fish and about three times during summer with the "babies," or those not yet arrived at the dignity of yearlings. Cannibalism is not only prevented by this, but the smaller ones will have a chance to get food at the first table, from which they have been debarred.

Perhaps a description of the ponds that I have made for the Fishery Commission of the State of New York at Cold Spring Harbor, Long Island, may best illustrate the idea of small ponds, first explaining that the object of the ponds is not only to grow trout, but to get the greatest amount of eggs for hatching in order to stock public waters with the different species of trout, such as

our native brook trout, the brown trout, or common brook trout of Europe, and the rainbow trout of California. The trout for distribution are sent out when about ready to take food—in March and April. Those to be kept at the station for breeders are fed in the troughs for a month or more, and are then put in the "baby ponds." These are of two-inch yellow-pine sides and one-inch bottoms, twenty-five feet long, three feet wide, and about twenty inches deep, with a strong flow and double screens of No. 8 wire cloth, between which is a dam an inch higher than the pond below. In these ponds are "rests," made of projections from the sides or of dams, with a surface stop-water a few inches below them, which causes the water to flow up and over the dam, and is then again deflected below. This keeps weak fish from being swept against the screens, and makes eddies for the food to swirl about in, instead of sinking. Mr. Hoxsie has patented an ingenious device to

TRYING THE BIG ONE WITHOUT HELP.

feed young fish in, and it is somewhat different from this plan which I used at Honeoye Falls, N. Y., in 1874 and since. Of these "baby ponds" we have ten, and, as we put ten thousand fry in each, we start in with only three of them stocked; but the little fellows have a way of getting around screens that are supposed to be tight, and before they are an inch and a half long some are found in the lower ponds, having gone through joints in the planks or sides or bottom, or around some loose screen, if not through a neg-

lected worm hole or nail hole. Their persistence in getting out of the place where they are put is wonderful.

When the fish are about six months old, say in September, they are taken out of the baby ponds, assorted in three or four sizes, and put in the yearling ponds, where they remain until the following year, when the largest are sent to the breeding ponds. At the same time the water is lowered in all the ponds, and they are thoroughly swept out preparatory to the taking of spawn, and the fish are not again disturbed until spring. The breeding ponds are cleansed in this way in midsummer, but all are daily gone over with long-handled nets to remove the ordure and any un-

When a Large Trout Struggles.

eaten food; the screens in the baby ponds are not taken out, but are cleaned with brooms or a scrubbing brush on a handle.

The breeding ponds are best if about sixty feet long, fifteen feet wide, and from two to three feet deep. In such a pond from one thousand to four thousand trout of half a pound may be kept if the flow is sufficient. If the supply of water is scant in summer, make the pond narrower or shallower, in order to give a quicker change to the fish.

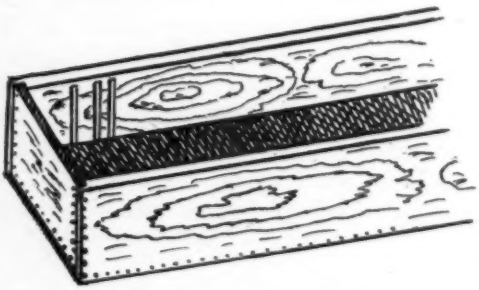
Each breeding pond must have a spawning race at its head, and these are narrow and shallow, making an ideal place for a trout to deposit its precious burden. They are from twenty-five to fifty feet long, two to three feet wide, with water from five to

ten inches deep. The bottom is covered with gravel of the size of a pigeon's egg, and the top with boards cleated together in convenient lengths to lift. Here are all the requisites of a nesting place—swift, shallow water, gravel, and shade, with its security from overhead enemies and light. If undisturbed, a pair of trout would whip a nest in the gravel and lay their eggs and retire after covering them, and the next pair would whip them out again in their efforts to perpetuate their species, and in a state of nature a horde of yearlings would follow the breeders to feast upon the eggs, for of all fish baits the eggs of trout and salmon are among the best. The spawning race is only to entice the trout to spawn there; a net on a frame sliding into grooves at the lower end is slipped in, the covers lifted, and the fish driven into the bag. They are then assorted. Those not ready to spawn to-day or later are thrown back into the pond, the ripe males are put into one tub and the ripe females in another, and to judge of this we note the swollen vent and the softness of the abdomen. This is the first test; the next is the ready flow of eggs.

Here it may be well to say, in nature not more than forty per per cent of the eggs are impregnated, owing to the failure of the milt to reach all the eggs. Of those that are impregnated fully one half are killed by the fungus that grows on the dead infertile eggs, and the remainder are subject to suffocation from freshets, depredations by young trout, eels, ducks, and other animals, as well as the sun, while in our so-called artificial propagation we get such a close contact of milt and eggs that the impregnation amounts to about ninety-five per cent, and there is no loss from sediment, fungus, enemies, nor direct sunlight. There is a loss of perhaps five per cent in deformed fish, such as crooked tails, double heads, twins with one umbilicus, and premature bursting of the shell, but we beat Nature in trout-hatching far more than we do in the breeding of any other animal, and the only comparison that seems fit is that of cultivating trees and plants, where we produce more than Nature can or does.

Our brook trout usually spawn from November to January on Long Island, in the early part of the day, while the lake trout, improperly called "salmon trout," spawn at night, thus preventing hybridization by means of drifting milt. About 8 A. M. we place a net at the foot of the spawning race and drive the fish that have run up for nesting into it. They are then put into tubs and assorted. The males are put together; the females that appear to be ripe are placed in other tubs, and those which are not near ripe are returned to the pond. A ripe male is known by its slim body and bright color; often his back will be buff, the sides scarlet, and the lower abdomen with a black stripe on each side. The ripe female is soft, and the vent is swollen and protruding. Un-

less the eggs flow at a light touch, it is better to return her to the pond, for eggs that have to be forced are not ripe, and if they can be fertilized make weak fish. For the manner of handling the fish, see illustrations from photographs. The so-called "dry method" is the best. A pan is wet and the water drained from it. The eggs of a female are taken by repeated strokes of the forefinger, if the trout is small, or by the hand if large. The eggs will be found to lie the full length of the body cavity, and the strokes begin near the vent and are then worked farther up toward the head. A bending of the back, as shown, often starts the eggs. This operation takes less time than it does to write it, and some water drips from the fish. A male is then stripped over the eggs and water enough to cover them is added, after which they are left to stand until they "free." The eggs are soft as they leave the fish, and for twenty minutes or more they absorb the milt and water, and while doing this they adhere to the pan, but become free when filled. They should not be disturbed until free, when they are washed by changing the water and then are placed on trays in the troughs. If an egg is not impregnated before it fills with water it never can be fertilized, and the advantage of this "dry method" over taking the eggs in a pan of water is that each egg is brought into contact with the milt, which suddenly becomes active when it comes in contact with water.

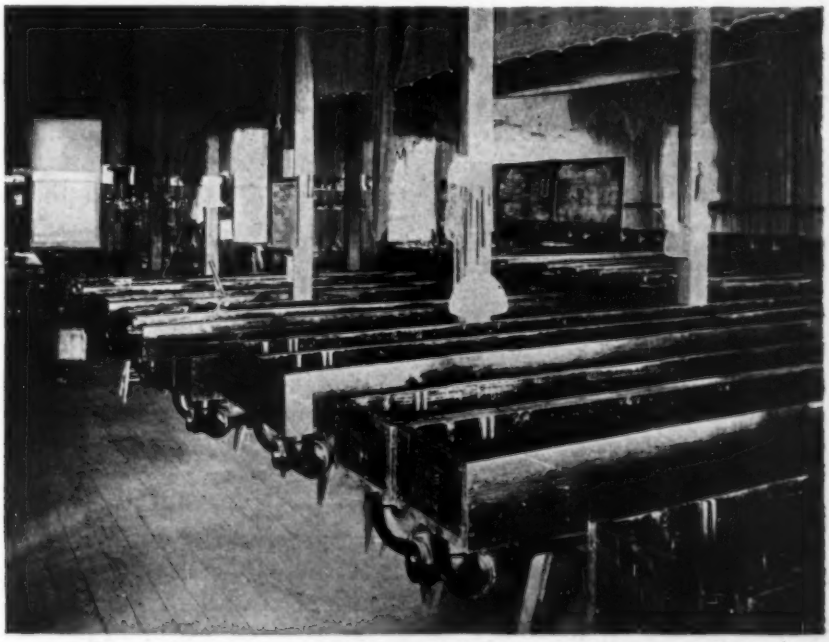


LOWER END OF HATCHING TROUGH.

This work and all troughs should be in a building and protected from storms and sunshine, but hatching troughs have been successfully worked in the open air. Rats are fond of trout eggs, sediment will smother the embryo within the shell, and direct sunlight will kill it. In a hatching house a distributing trough should run the length of one side. If this is ten inches wide and nine inches deep, with occasional cleats on top to prevent spreading, it will be about right. The water may flow in at one end and out at the other, over a dam six or seven inches high. With hatching troughs at right angles to this and supplied by inch-and-a-half cocks or gates the flow will be regular at all times. These cocks should be halfway between the bottom of the distributing trough and the surface of the water, and may have a fine screen above them, or may pour into one below, as seems best, always looking out that the flow is not stopped nor any fine material

enters the trough that would clog the screen at the lower end of the hatching trough and cause it to overflow and the fry to escape.

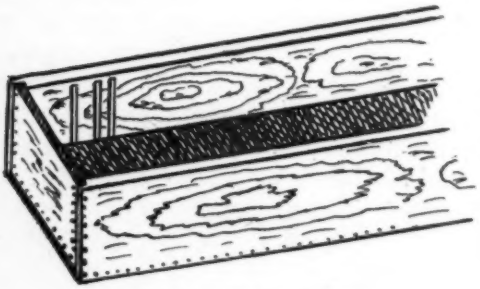
These hatching troughs are best made of soft wood, preferably sound, clear white pine, and if possible have them up so that the tops are three feet six inches above the floor, for convenience in working over them. If the bottoms are an inch and a half thick, three carpenter's horses will sustain them. A trough thirteen feet long, fourteen inches and a quarter wide, and seven inches deep, inside measure, will be sufficient for twenty-five thousand trout fry after they are hatched and feeding, but will be capable of developing four times that number of eggs. The troughs should be made of regular width, to a hair's breadth, in order to have any hatching tray fit every trough in any part of it, and the edges of the bottoms should be carefully dressed and the



LOWER ENDS OF TROUGHS WITH OUTLET PIPES.

sides nailed to them after being touched with thin white lead. The ends should be let in (see cut), in order to be nailed both ways and be tight. An inch-and-a-half hole in the bottom of the lower end will take the waste water where required; a sink outlet with the cross-pieces cut out is good to attach a waste-pipe to; above this hole nail an upright strip to each side to hold the dam. During the egg stage use one of two inches or less; after hatching

less the eggs flow at a light touch, it is better to return her to the pond, for eggs that have to be forced are not ripe, and if they can be fertilized make weak fish. For the manner of handling the fish, see illustrations from photographs. The so-called "dry method" is the best. A pan is wet and the water drained from it. The eggs of a female are taken by repeated strokes of the forefinger, if the trout is small, or by the hand if large. The eggs will be found to lie the full length of the body cavity, and the strokes begin near the vent and are then worked farther up toward the head. A bending of the back, as shown, often starts the eggs. This operation takes less time than it does to write it, and some water drips from the fish. A male is then stripped over the eggs and water enough to cover them is added, after which they are left to stand until they "free." The eggs are soft as they leave the fish, and for twenty minutes or more they absorb the milt and water, and while doing this they adhere to the pan, but become free when filled. They should not be disturbed until free, when they are washed by changing the water and then are placed on trays in the troughs. If an egg is not impregnated before it fills with water it never can be fertilized, and the advantage of this "dry method" over taking the eggs in a pan of water is that each egg is brought into contact with the milt, which suddenly becomes active when it comes in contact with water.

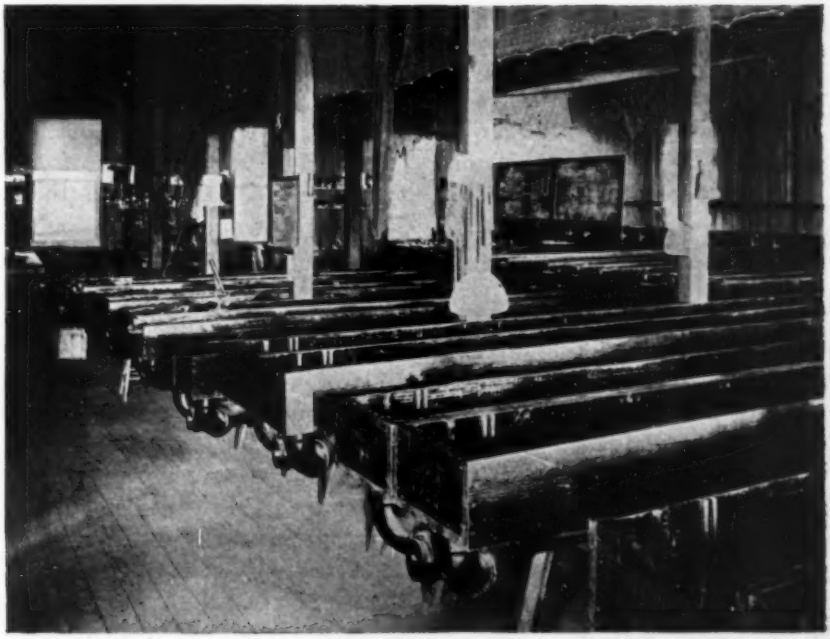


LOWER END OF HATCHING TROUGH.

This work and all troughs should be in a building and protected from storms and sunshine, but hatching troughs have been successfully worked in the open air. Rats are fond of trout eggs, sediment will smother the embryo within the shell, and direct sunlight will kill it. In a hatching house a distributing trough should run the length of one side. If this is ten inches wide and nine inches deep, with occasional cleats on top to prevent spreading, it will be about right. The water may flow in at one end and out at the other, over a dam six or seven inches high. With hatching troughs at right angles to this and supplied by inch-and-a-half cocks or gates the flow will be regular at all times. These cocks should be halfway between the bottom of the distributing trough and the surface of the water, and may have a fine screen above them, or may pour into one below, as seems best, always looking out that the flow is not stopped nor any fine material

enters the trough that would clog the screen at the lower end of the hatching trough and cause it to overflow and the fry to escape.

These hatching troughs are best made of soft wood, preferably sound, clear white pine, and if possible have them up so that the tops are three feet six inches above the floor, for convenience in working over them. If the bottoms are an inch and a half thick, three carpenter's horses will sustain them. A trough thirteen feet long, fourteen inches and a quarter wide, and seven inches deep, inside measure, will be sufficient for twenty-five thousand trout fry after they are hatched and feeding, but will be capable of developing four times that number of eggs. The troughs should be made of regular width, to a hair's breadth, in order to have any hatching tray fit every trough in any part of it, and the edges of the bottoms should be carefully dressed and the



LOWER ENDS OF TROUGHS WITH OUTLET PIPES.

sides nailed to them after being touched with thin white lead. The ends should be let in (see cut), in order to be nailed both ways and be tight. An inch-and-a-half hole in the bottom of the lower end will take the waste water where required; a sink outlet with the cross-pieces cut out is good to attach a waste-pipe to; above this hole nail an upright strip to each side to hold the dam. During the egg stage use one of two inches or less; after hatching

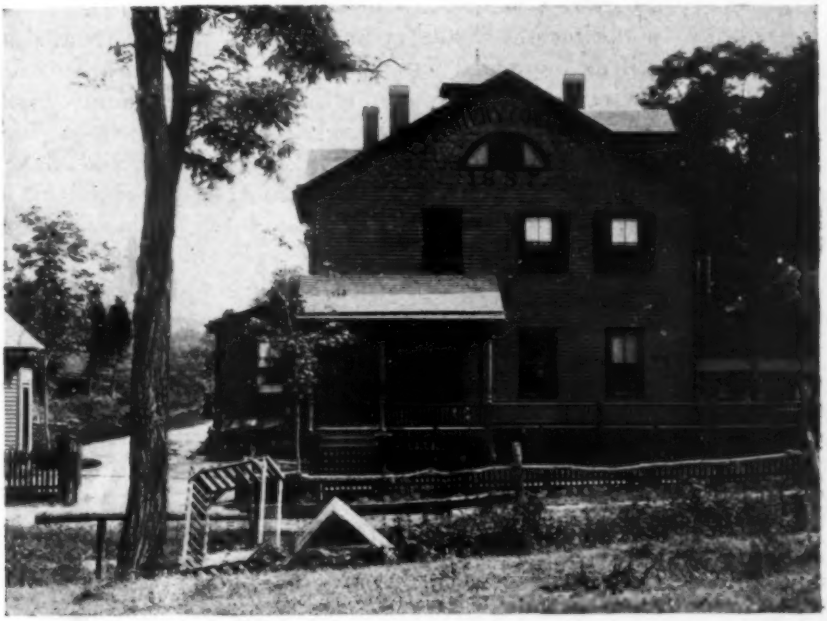
begins, put in one of five inches and a screen above it. Just above the dam put two strips each side to hold the screen, which must fit tight all around, or tails will get in cracks and the fish will die. This screen should be of No. 14 wire cloth, and is sometimes placed upright and at others with its top up stream to give more surface and to release a weak fish from it by its own weight, but the difficulty in keeping a screen so placed clean is an offset to its advantages. If space permits, the troughs should be placed by twos, but some prefer them by threes.

COAL TAR.—All troughs, screens, trays, and all wood and iron that is in contact with water, should be painted with coal tar, which can be had from the gas-works. Thin it with spirits of turpentine, and give it two or three coats with a half-worn painter's brush in hot weather. It must be perfectly dry before water is let in, and then there will be no taste, rust, flavor of pine, nor fungus. Asphaltum is used, but I have not tried it. After the first season one coat each year is sufficient.

If the hatching troughs are all exactly one width, make the trays one quarter of an inch narrower and about twenty-seven inches long; use half-inch pine, cut in strips three quarters of an inch wide and laid flat, so that the frame is only half an inch deep; make the corners strong. If the frames are fourteen inches wide outside, have wire cloth especially woven of a length to cover them all, but half an inch narrower than the frames, for the selvage will be uneven; have it made with a mesh three quarters by an eighth of an inch, the long way of the mesh across the cloth; this holds the egg, but lets the fish drop through. Use No. 18 wire for the cross-wires, and finer wire for the double over and under, for the warp. A double-pointed carpet tack under each corner of the tray allows circulation beneath and prevents crushing the fry.

Having shown how to make the troughs, screens, and trays, and how to take the eggs, we must now proceed to the care of the eggs and fry. Our implements are few and simple: a wisp broom, a pair of nippers, a small, flat net, and the wing-feather of a goose set in a handle of light wood are all, except an outfit of pans which are to be used in stripping the fish. The little hand broom is used daily; a tray of eggs is taken from the bottom of the trough and soused in and out of the water to remove sediment, and is put over into the next trough, etc. When all are out, the dam below is removed and all slime washed out and both dam and eggs replaced. The nippers are cut out of wood, red cedar preferred, and are about six inches long, with a spread of three quarters of an inch at the points; the latter are best when finished with a loop of brass wire, but can do good service without this. A dead egg turns white, and can be seen at a glance

among the amber ones, and an egg that has not been fertilized often remains clear until the rest are nearly hatched, but it can not stand any rough usage, and shows up in numbers after each washing, and, if left for two or three days, will develop a fungous growth that will attach the surrounding eggs in a mass and kill them all. In our early work, when we hatched on fine gravel, fungus was the bugbear: a dead egg would get down in the gravel and send out its deadly tentacles unseen; but with wire cloth and daily supervision fungus is unknown. It is this that kills the eggs in the brooks, and avoiding this cause of mortality from



FRONT OF HATCHERY, SHOWING INLET TRUNK FROM RESERVOIR.
By courtesy of Mr. W. H. Cooper, President of the Photo-Section, Brooklyn Institute.

unimpregnated eggs is one of the reasons why we beat the methods of Nature in increasing a species by protection from its enemies.

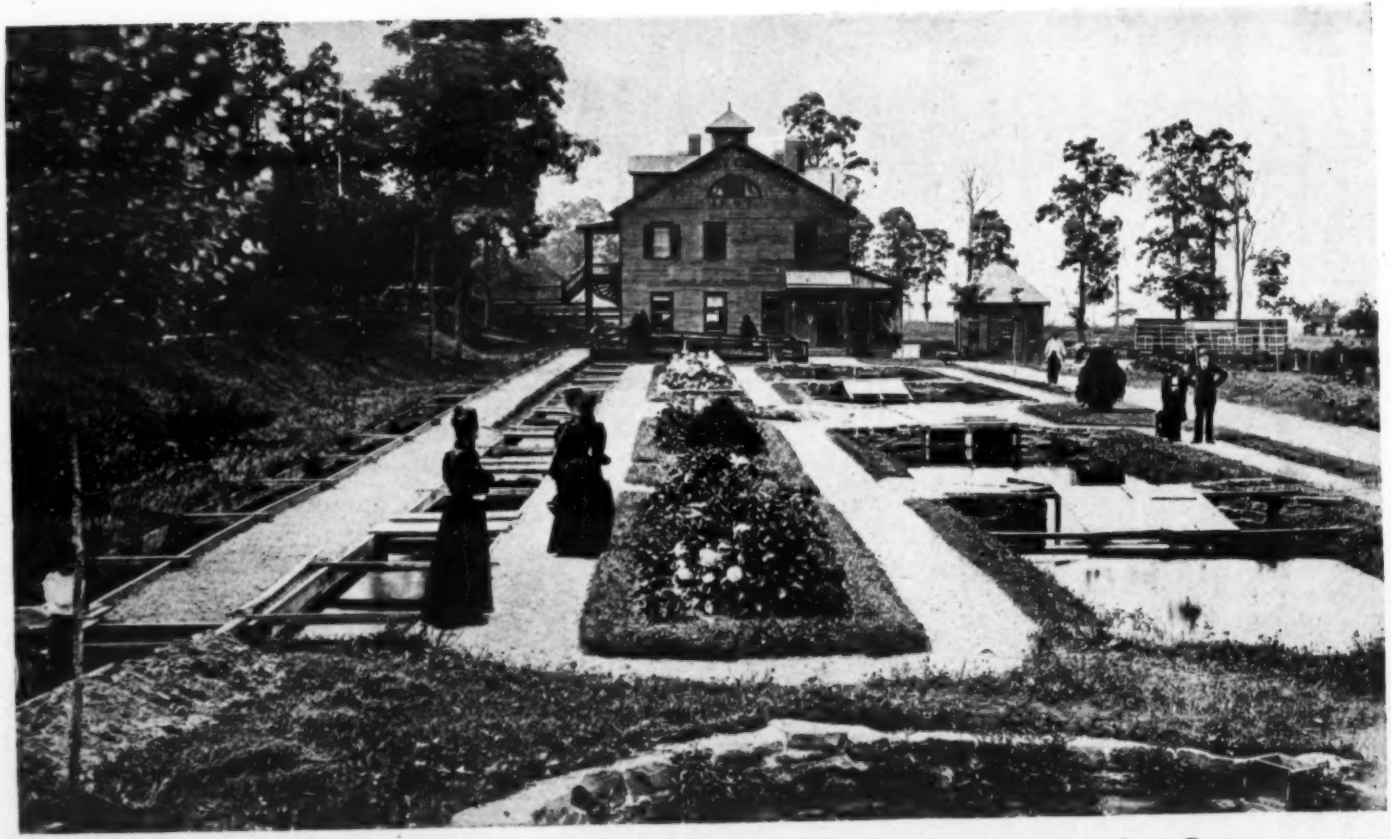
At about fifteen days old the expert can take trout eggs in a glass tube or vial and, by holding them above his eye, can see the line of vertebræ which marks the impregnated egg; a few days later he can pick out the "ringers," or eggs which, having no fish in them, retain the ring which they first had on top of the egg. At thirty days, more or less, according to temperature, the eyes show, and the development goes on until the hatching begins at sixty to ninety or more days, according to the thermometer, but the colder waters produce the strongest trout.

When hatching begins, the water in the trough is raised, and the trays are brought near the surface and held there by light wedges which do not spring the sides of the troughs. The feather sweeps the bottom of sediment, taking care not to injure the delicate embryos, for they are more delicate when first hatched than when in the egg. At this time cleaning should be confined to the removal of any dead eggs or fry and of egg-shells on the screen, and here is where the little flat net of milliner's "millinet," on a three-inch brass-wire frame, is found most useful. This wire is covered with muslin to which the netting is sewed, and, moved quickly through the water, it gathers the shells which are clogging the screen, and a smart rap on a pan cleans the net. It is also of use in taking out dead fry and foreign matter from the bottom, as well as deformed fish, for we find crooked-tailed fish that can not swim and take food, double-headed fish, and twins attached to one sac, which never live.

When first hatched the embryo trout hardly look like fish; they have simply burst the shell in which they appeared as a slim, dark body, with big eyes, coiled around the yolk, and now merely straighten out and have the great yolk-sac still attached, and so heavy that they can not swim, but lie on their sides and huddle together to avoid light; and now there is danger of the bottom ones being smothered. Cover the trough in spots to induce them to gather in different places, and keep them as dark as possible. At this stage there is nothing to do but to remove the few dead—sediment can not hurt them now—and keep the outlet screen free. When they get to be about a month old the sac will be nearly gone, and the fry begin to show signs of swimming by occasional darts from the bottom to examine some floating particle. They will take food some days before the sac is absorbed, and it should be offered to them in small quantities.

The best food that I have found is beef liver, after abandoning it for soft clams (*Mya arenaria*) salt-water mussels, and horse meat. The clams made the young fish grow fast, but did not produce the expected number of eggs; the mussels were tried raw and cooked, with the same result; and, as the principal object at this State hatchery was the production of fry for planting public waters, we next tried raw horse flesh, which was very objectionable on account of the large proportion which was passed undigested and clogged the screens and fouled the water. Several fish culturists have found an admixture of bran, shorts, or mill feed with liver to be excellent. This I have not tried, because the trout is not a vegetarian in the least degree, and it remains to be proved that such vegetable addition to the food is of real advantage.

The liver is fed raw; for the "babies" it is run through a



Rearing and Breeding Ponds at Cold Spring Harbor, showing Sunshades and Spawning Races for Large Ponds.
By courtesy of Mr. W. H. Cooper, President of the Photo-Section, Brooklyn Institute.

meat cutter having holes one thirty-second of an inch at first, the holes increasing in size as the fish can take larger particles. This is mixed with sufficient water, and little by little scattered along the troughs from a wooden spatula, taking care not to feed so much at once that it will not be eaten. With twenty troughs one man should feed all day, getting back to the first one in half an hour, for, like all small animals, the trout want but little at a time, but want it often. For this reason I never advise a novice who receives fish from the State to pen them up and feed them; they would surely be starved, for if the young are not fed a dozen times a day they will show it by a shrunken body which appears to be all head. A trout at two to three months old should be larger around the abdomen than about the head, and there should be no pinched look behind the gills. If you can not give the babies this care, turn them into the stream or lake, and let them find their food and face their enemies, and you will have more and better fish. To take trout eggs and hatch them is not difficult, but the best trout breeder is the one who brings the greatest percentage of what he has hatched to be thrifty fish at six months old.

For the yearling trout the liver may be cut in pieces from a quarter to half an inch, and they should be fed all they can eat at least twice a day. Larger fish will take more and larger pieces, and will get along if fed once each day, preferably in the evening, but they do not suffer if neglected for a day as the babies do, and we find the same rule all through animal life in mammals and birds, with which most people are more familiar—the young require frequent feeding.

Too much importance can not be attached to the feeding of the fry in the early days of their taking food. It is the critical time, not only of their lives, but of their future development. No amount of feeding can make a thrifty fish of one which has been stunted by scant food in its first few months of life, and right here is where intelligent care turns the scale between profit and loss.

During the quarter of a century in which I have been engaged in this work, and have had to trust the care of the fish to employees because my own time was fully occupied with other work, the man most valued was he who took best care of the babies and fed them as though he loved them, and not in the spirit of one who did it as a task.

If one wishes to raise trout on artificial food he must bend to the task as he would if he were to raise any other stock in quantities in confined quarters; but he can arrange natural spawning races, and either take the eggs by hand or let them be laid by the fish, and be satisfied with a much less number of fish hatched,

and then let them take care of themselves in a large pond or lake of suitable temperature, and, if the water is not infested with sunfish, perch, and other enemies which are beginning to look for food in the spring when the young trout is also looking for its first food, there is every prospect of success.

RECENT RECRUDESCENCE OF SUPERSTITION.

By Prof. E. P. EVANS.

I.

IN 1879 a Catholic professor of theology in the University of Bonn, Dr. Heinrich Reusch, published a little volume entitled Die deutschen Bischöfe und der Aberglaube (The German Bishops and Superstition), in which he called attention to the vast increase of superstitious beliefs and observances within the Catholic Church since the middle of the present century, and to the official approval and promulgation of them by the highest ecclesiastical authorities. He animadverted severely on the extent to which this tendency had tainted the religious literature most widely diffused by the clergy among the masses of the people, and censured especially the pious pamphlets and periodicals issued by the Jesuits, such as Monat-Rosen zu Ehren der Unbefleckten Gottes-Mutter Maria, and Der Sendbote des götthichen Herzens Jesu, both of which are edited by disciples of Loyola at Innsbruck under the auspices of the Bishops of Salzburg, Brixen, and Trent, and with the benediction of Pope Pius IX. In these monthly sheets one would seek in vain for a moral maxim or practical precept inculcating kindness, truthfulness, and honesty in the common relations of life, but their pages are filled with records of miracles wrought and demons discomfited by consecrated medals, chrisms, holy waters, sacred scapularies, seraphic girdles, and relics of the saints.

During the fifteen years that have elapsed since Prof. Reusch uttered his earnest protest against this gross abuse of sacerdotal functions and spiritual power, the evils which he lamented and endeavored to correct have grown decidedly worse. In Germany the most important of the influences and events that have contributed to this deplorable result was the so-called *Kulturkampf*, or antagonism of the state to the Church in the interests of modern culture as opposed to the arrogant claims of a mediæval hierarchy. The inevitable effect of this conflict was to consolidate the forces of ultramontanism and to render them supreme in the papacy, to bind priests and people more firmly together, and to

alienate the clergy from the cultivated classes of civil society. Universities have been superseded to a considerable extent by cloistral schools and special seminaries for the instruction of ecclesiastics, who, in consequence of such intellectual isolation, are as ignorant of the achievements of modern science and the chief currents of modern thought as though they lived in the ninth instead of the nineteenth century. Quite recently the German Imperial Government suggested the desirability and indicated the intention of establishing a Catholic faculty of theology in connection with the University of Strasburg; but the project was disapproved by the Alsatian bishop and met with general opposition on the part of the Catholic press in Germany, so great was the distrust of any intimate association with the centers of higher secular education. Also the convention of Catholics held at Cologne during the last week in August, 1894, expressed no word in favor of the afore-mentioned plan, but passed a resolution urging the immediate founding of a university at Fulda, which should be sanctioned by the Pope, controlled by the bishops, and wholly independent of the state. The kind of instruction which young men would receive in such an institution may be easily imagined. The hexahemera of the fathers and the works of Albertus Magnus would be the text-books in natural science, while theology and philosophy would be nothing but a rehash of the quiddities and quodlibets of Thomas Aquinas and Duns Scotus.

Two books recently published may be cited as fair specimens of the sort of researches to which the professors of the proposed Fulda University would probably devote their time and talents. The first of these volumes is entitled Wunder und göttliche Gnadenerweise bei der Ausstellung des heiligen Rockes zu Trier im Jahre 1891; aktenmässig dargestellt von Dr. Felix Korum, Bischof von Trier, of which a fourth edition has just been issued by the Paulinus printing office in Trier (Treves). When it was announced in 1890 that the "holy coat" of Trier would, after a lapse of forty-six years, be again exhibited for the adoration of the faithful, many sincere Catholics could hardly believe that, in the latter half of the nineteenth century, such an appeal to the crassest religious credulity would be made, or that it would meet with any general response. Nevertheless the exhibition took place in the following year and was crowned with immense success. Vast crowds of people flocked to the sacred shrine, and rumors went forth throughout the land of persons who had touched the garment and proved its miraculous virtue by being healed of their infirmities. This immense concourse of devotees presented to the eyes of the bishop a "glorious spectacle" and is characterized by him as in itself a "moral miracle"; a mind less blinded by bigotry, and therefore more capable of tracing the logical con-

nection between cause and effect, would discover in this marvelous phenomenon only the natural result of the kind of religious instruction that has been systematically imparted by the Catholic clergy to the souls intrusted to their special care and spiritual cure during the last fifty years, and against which Prof. Reusch deemed it necessary to utter his solemn words of protest and of warning.

Dr. Korum seeks to give his *brochure* a quasi-scientific character by a so-called "documentary representation" of the miracles wrought by the "holy coat," consisting of certificates issued by obscure curates and country doctors and indorsed by an episcopal commission of theologians and physicians, who have very discreetly forgotten to sign their names to their reports and thus relieved themselves of all personal responsibility for their opinions. The Council of Trent decreed that no new miracles are to be accepted as authentic unless allowed and approved by the diocesan bishop, who, after taking the advice of theologians and other pious men, is to come to a decision which shall be consentaneous to truth and piety (*veritati et pietati consentanea*). Unfortunately, the interests of truth and piety are not always identical, and the demands of the former are apt to prove fatal to the claims of the latter. The diseases reported by our author as having been healed were nervous and hysterical affections, chorea or St. Vitus's dance, and a few cases of certain milder forms of lupus and tabes, which, as is well known, often disappear for months and even for years without the aid of medicine or miracles. It is also essential to a miracle that the afflicted person should be instantaneously relieved, or "cured from that very hour." The bishop, however, records no instance of this kind; as a rule, a very considerable time elapsed, often weeks and months, before the contact with the "holy coat" began to produce any perceptible effects; meanwhile the patient had been subject to a variety of sanitary influences, such as change of scene and other diversions, any one of which might have brought about the desired result, and in some cases also underwent medical treatment. Under such circumstances it would be the height of absurdity even for those who admit the possibility of the miraculous healing of disease to claim that the recovery was due to supernatural causes. Indeed, of the thirty-eight cures said to have taken place during the exhibition of the "holy coat," Dr. Korum owns that twenty-seven may have been effected by natural means, thus leaving only eleven in which he would fain discover the working of divine agencies.

One of the most eminent of modern neuropathologists, the late Prof. Charcot, published shortly before his death an interesting paper on faith-healing, in which he acknowledges the reality of

the cures performed by this means, and states that his own practice furnishes many examples of the kind; but every therapeutic miracle, he adds, has its explanation, and we are gradually becoming better acquainted with the laws which govern the origin and evolution of such phenomena, and better able to trace them to their natural causes. Two factors are absolutely essential to cures of this kind: first, a peculiar mental constitution of the patient, easily accessible to confidence, credulity, or, as it is now called, suggestibility; secondly, a certain definite form of disease confined to a very small province in the domain of therapeutics, and comprising only those affections which the influence exerted by the mind upon the body suffices to heal. To this class of ailments belong partial or complete paralysis, cramps, convulsions, and similar functional disorders, tumors and ulcers, muscular atrophy, defective vision and other troubles of a hysterical nature, which can be cured by hypnotic suggestion, or by impressing upon the mind of the patient the conviction of their nonexistence, or by appealing to the firm belief in some remedy which has no intrinsic virtue. Under such circumstances a cripple may recover the use of his limbs simply by being commanded to rise up and walk, or a person suffering from *tabes dorsualis* may be restored to health and strength by wearing a holy relic of high repute or by going on a pilgrimage to some wonder-working shrine. In both cases the cure is effected by the exercise of credulity under more or less morbid and abnormal conditions produced either by somnambulism or superstition; but in neither case is the result attributable to supernatural causes. The sole aim of the physician is to heal the sick, and he should be liberal-minded enough to make use of any remedy which experience has proved to be effective—it may be a pill or a pilgrimage, a dose of sulphur or devotion to a saint. In conclusion, Dr. Korum declares that "the Lord by these marvelous manifestations of his almighty power has in a special manner indorsed and confirmed the worship of relics," and adds that "the occurrence of so many miracles in our enlightened nineteenth century is annihilating to the haughtiness of scientific research." The good bishop does not seem to be aware that the events which he records, admitting the accuracy of his descriptions, are merely illustrations and confirmations of the most recent scientific researches and discoveries in the province of neuropathology.

Dr. Korum also endeavors to show that miracles involve no violation of the laws of Nature, but are only the temporary counteraction of their ordinary effects through the operation of higher laws. The following example may serve as a specimen of his reasoning on this point: A stone falls to the ground in obedience to the law of gravitation; the human arm or other agency

may cause it to rise into the air; this upward movement is, however, no violation of the law of gravitation, but merely a counteraction of its usual workings through the intervention of a superior force; therefore, miracles are wrought without violating natural laws. We commend this palpable *non sequitur* to any writer who wishes to make a collection of peculiarly gross fallacies for a work on logic.

An admirable reply to Dr. Korum's book is a *brochure* of eighty-three pages written by Friedrich Jaskowski, and entitled Der Trierer Rock und seine Patienten vom Jahre 1891 (Saarbrücken: Carl Schmidtke, 1894). The author is a Catholic priest in the diocese of Trier, and therefore under the jurisdiction of the bishop, the absurdity of whose statements and the untenableness of whose arguments he so courageously exposes and so conclusively refutes. The holy coat, he says, has been in the custody of the cathedral since the twelfth century, and was exhibited and adored as a sacred relic probably a dozen times from 1512 to 1810, but during these three centuries no healing virtue or wonder-working power was ever ascribed to it. In 1810 some ignorant and superstitious devotees reported that miracles had been wrought by it, but these stories were not indorsed by the ecclesiastical authorities. Not until 1844 did the popular demand for miracles become so loud and persistent that Bishop Arnoldi finally yielded to it and announced officially that "bodily wonders" or miraculous cures had been performed. If the holy coat can restore the sick, Jaskowski thinks it rather odd that it should have no power of self-restoration; it gets moldy when shut up in a damp closet, wears out by use, and has to be cleaned, darned, and patched like any other garment. The miracles of healing cited by Dr. Korum are then subjected to a critical examination and shown to be utterly unworthy of credence. In several instances the persons said to have been cured died shortly afterward. Of the thirty-eight cases cited, thirteen were men and twenty-five women. "This predilection for the fair sex" is a rather suspicious circumstance, indicating that the maladies were mostly hysterical and nervous and might be easily ameliorated by any influence that would powerfully affect the imagination, without the aid of either medicine or miracles. Jaskowski quotes Prof. Charcot, Dr. Forel, and other neuropathologists to prove that hetero-suggestion emanating from a physician or priest, or auto-suggestion originating in the person's own mind, may often be the most effective remedy for disorders of this kind. In auto-suggestion the patient is possessed with the fixed idea that the doing of a certain thing, which may be in itself absolutely indifferent, will afford relief; as an example of this faith-cure Jaskowski refers to the woman who was diseased with an issue of blood, and approaching

Jesus said within herself, "If I may but touch his garment, I shall be whole." This is precisely the position taken by Jesus himself, who turned to the woman and said: "Daughter, be of good comfort; thy faith hath made thee whole." On another occasion it is expressly declared by the evangelist that in a certain place the unbelief of the people, or their lack of faith, prevented the doing of many wondrous works. Jaskowski does not deny that on this principle, which is now recognized by the most eminent physicians, some persons may have been restored to health by touching the holy coat of Trier; and there is no doubt that the popular belief in Bishop Korum's assertion that it is the same garment which Jesus wore and the woman touched, would greatly increase its healing efficacy through the force of auto-suggestion. In conclusion Jaskowski declares that the cases of healing, so far as they actually occurred, "were not due to a miracle or any direct interference of God with the established course of things, but happened in a purely natural manner."

The success, both devotional and pecuniary, which attended the exhibition of the holy coat of Trier in 1891 on German soil excited the religious and patriotic zeal of French Catholics, who resolved to try what healing virtue might still inhere in the "holy-seamless coat" of Argenteuil. This rival relic, the gift of the Byzantine Empress Irene to Charlemagne, had not been officially exposed and had its therapeutic powers publicly tested since 1680, and it was decided that the "elevation" should take place from May 14 to June 10 in the year of grace 1894. No sooner was this announcement made than it greatly alarmed the jealousy of Trier, whose bishop published a pastoral letter denying the genuineness of the coat at Argenteuil, and inviting the faithful to pay their devotions only to that at Trier. This view was also taken by a French ecclesiastic, the Benedictine Abbé Vonel, who wrote a pamphlet declaring that the legend of the Argenteuil relic had no historical foundation, and that the whole thing was merely a "pious illusion," which the Church should have sufficient love of truth as well as sense of her own worthiness to repudiate. This conclusion filled the inhabitants of Argenteuil with consternation; especially the tradesmen and innkeepers of the little town on the Seine uttered loud and indignant protests against the attempt to tarnish the traditional glory of this sacred shrine and to diminish the prospect of putting money in their pockets, while the people of Trier rejoiced at the condemnation and probable extinction of a dangerous competitor. At this juncture Monseigneur Richard, Archbishop of Paris, intervened and induced the Abbé Vonel to withdraw his *brochure* from publication. In order to remove any lingering traces of skepticism from the public mind, the Bishop of Versailles submitted a small piece of the holy seam-

less coat to the chemists of the Gobelin manufactory, who reported that the web might possibly date from the time of Christ, and that the stains may have been produced by blood; whether it was really the vesture upon which the Roman soldiers cast lots they would not undertake to decide. This vague and utterly worthless document was eagerly seized upon by the bishop and printed in the newspapers as a confirmation of the truth of ancient tradition by modern science.

We may add that the ecclesiastical authorities of Argenteuil do not deny the genuineness of the relic at Trier, but only assert that it is an upper garment, one of those which Christ's crucifiers parted among them, whereas theirs is an under garment, worn next to the skin, and therefore endowed with greater healing virtue than could possibly be possessed by a mere overcoat. The masses, however, do not seem to have been seriously affected by the accusations and recriminations passed backward and forward between the guardians of the two shrines vying for public patronage. On May 14th, the first day of the "elevation," thirty-seven extra trains left Paris for Argenteuil, and forty-two thousand persons paid their devotions to the wonder-working coat; and when the exhibition closed on June 10th half a million pilgrims had visited the little town on the Seine where, nearly eight centuries ago, the youthful Héloïse took the veil after her separation from Abélard. That thousands were healed of otherwise incurable diseases, and the maimed, the halt, and the blind recovered the use of their limbs and had their sight restored, has undoubtedly been fully recorded, and will in due time be officially reported.

Meanwhile the Bonapartists made a bold attempt to take the tide of popular superstition at the flood, hoping it might lead on to political fortune. One of their agents, while kneeling in adoration before the holy seamless coat, claims to have received a divine revelation through the newly canonized tutelar saint of France, Joan of Arc, who, it seems, has already begun to take a hand in French politics and to utter prophecies concerning the future of the land of which she was once the divinely commissioned defender. According to this revelation from on high, which has been printed on a single sheet of four large octavo pages and distributed in thousands of copies among the rural population and in the provincial towns, Prince Victor Napoleon V is the predestined ruler of France, and will be elected to the presidency of the republic by popular suffrage, or attain to sovereignty after bloody civil contests. In either case, Alsace and Lorraine will, on his accession to power, be reunited to France either through diplomatic negotiations or as the issue of a short but sanguinary foreign war. The recipient of this communica-

tion asserts that he is now seventy-two years of age, but that God had assured him, through the mouth of the Virgin, that his eyes shall see the salvation of France, and that he shall not die until these predictions have been fulfilled. That such crass superstition should be made the means of political propagandism in the last decade of the nineteenth century is certainly a strange phenomenon.

Another book indicating the rank growth of superstition in recent times is Dr. Theobald Bischofberger's Die Verwaltung des Exorcistats nach Massgabe des römischen Benediktionale, of which a new edition, revised and enlarged, was published by Roth at Stuttgart in 1893. The author evidently prides himself upon his powers as an exorcist, and relates with great unction and assurance his experiences in casting out devils by a hocus-pocus worthy of an American medicine-man or an African conjurer. In the section of his manual entitled Recognition of Demoniac Diseases he states that the signs of diabolical possession are quite conspicuous, but not altogether infallible, such as understanding foreign tongues without having learned them, and revealing the place where objects have been hidden, a peculiar faculty now known as mind-reading. Some persons thus affected are subject to fits of fainting; others shake and shiver as though they had the ague; others break out into profuse perspiration, or are seized with an irrepressible tendency to yawn, often developing into chronic oscitation. Sometimes the symptoms are imperceptible to the observer, as when the patient complains of internal heat, or suffers from constriction of the head, confusion of ideas, roaring in the ears, and similar troubles. Dr. Bischofberger admits that disorders produced by demons are difficult to distinguish from those due to natural causes. Thus the paroxysms of an epileptic who is diabolically possessed do not differ from those of an epileptic who has anæmia of the brain or other cerebral affection. The sensations of the *aura epileptica* and the convulsions that follow them are the same, whatever may be their origin. There is, however, one sure means of determining whether a disease is demoniac or not—namely, the use of the *præceptum probativum* or *exorcismus probationis*, by which the demon or demons, if there are several of them, are commanded in the name of Jesus to give a clear and manifest sign of their presence, and, if they have any power over this creature of God in his sickness, to agitate him and do the same things in the presence of the exorcist that they have been wont to do in his absence: Præcipio tibi dæmon, vel vobis dæmonibus, si plures sitis, in nomine Jesu, ut mihi aliquod signum evidens et manifestum faciatis vestriæ præsentiæ, si aliquam potestatem habeatis in hanc creaturem Dei in hac ejus in ægrotatione, agitando eam vel coram me aliquid ex iis faciendo,

quod me absente in ea faciebatis—in nomine Pa+tris, etc. While repeating this formula, which is efficacious only in Latin, the priest is to lay his hand or, better still, some holy relic on the person possessed. "This conjuration," says our author, "may make the ungodly laugh, but the devil must obey and make his presence known, so great is the potency of these words." If the evil spirit were ordered to come out of the person, the command might not be obeyed, owing to some moral or physical obstacle to the demon's exit, which must first be removed; but if told to give a sign of his presence he must do so; otherwise (and mark the peculiar cogency of the priest's logic) there would be no truth in the apostle Paul's assertion that "at the name of Jesus every knee should bow, of things in heaven, and things in earth, and things under the earth. . . . The inhabitants of heaven," he adds, "bow the knee in rapturous devotion, the pious children of the Church in humble faith, and the spirits of hell with repugnance and gnashing of teeth, but they yield to compulsion and bow the knee."

Herr Bischofberger prudently leaves many a loophole of escape in case of failure: the demon may refuse to obey if the priest lacks faith, or utters the words in jest, or lives an evil life, or if the patient has little or no faith, or by the commission of a deadly sin has fallen into the toils of Satan, who has thus acquired an irreversible right to his soul. One would think that these exceptions would cover most instances of obstinacy on the part of the demon. Our author states that often, in his own experience, "the *præceptum probativum* did not produce any effect until the patient had made a general confession and received full absolution." He also notes that devils, like all evil-doers, are fond of going about in disguise, and if they perceive that they hold possession by a precarious tenure, and that their *incognito* is endangered, they will sometimes depart before the exorcist asks their names, or practice all sorts of equivocations and evasions, like a criminal under inquisition of the police.

If the demoniac infestation is connected with a physical malady of any sort, the case becomes exceedingly complicated, and the exorcism is attended with great difficulty, since the evil spirits obstinately resist all efforts to expel them by intrenching themselves in the ills that flesh is heir to. Diabolical possession, if permitted to continue for a long time, finally gets to be chronic and inveterate, and develops into an organic and incurable disease. Very often, too, it is quite impossible to determine whether the demon is the originary cause of the malady or merely takes occasion of it to get possession of the person through the breach made by illness, like an enemy lying in wait and ready to seize every opportunity to assault the temporary citadel of the soul. Wom-

en, however healthy, are, from the very nature of their sex, subject to various bodily indispositions from which men are wholly free, and are therefore more liable to demoniac affections; hence the vast number of unfortunate women who have suffered as witches in times past, not necessarily because they were wicked or morally corrupt, but because they were weak, the devil taking advantage of their physical infirmities to get possession of their persons and to make them the agents of his will.

The theory that "sin is the source of demoniac infestations" is accepted by Dr. Bischofberger only in its general application to the human race; if applied to individuals and families, he thinks it often works great injustice. He censures the conduct of many guardians of souls, who say to those afflicted by demons: "It serves you right; you ought to lead a different life; Satan has power only over bad people." Such remarks betray a lamentable ignorance of the devil's devious ways and cunning devices. Equally reprehensible is it to tell mothers who seek help from the Church for their suffering children: "Your child has been baptized and is in a state of saving and sanctifying grace and inaccessible to devils. You must consult a physician." The truth is, adds our author, little children are very frequently demoniacally possessed for the same reason that women are; on this account the old diocesan benedictionals contained a special *exorcismus parvulorum a dæmone infestatorum*, which has now been in a great measure superseded by the equally effective formula *benedictio puerorum ægrotantium* of the Romish benedictional.

In illustration of his views on this subject Dr. Bischofberger asserts that a place where a murder or other heinous crime has been committed, if the offense remains undetected and unexpiated, is sure to become the haunt of evil spirits and the scene of all sorts of diabolic orgies, such as are so frequently described in the annals of witchcraft. This state of things may continue for centuries, and a house or barn built upon such a spot will be demoniacally infested, to the great annoyance of the indwellers, whether men or cattle. The same is true of houses whose inhabitants have been guilty of gross iniquities, murder, brutality, blasphemy, caricature of sacred rites, mockery of holy things, necromancy, etc. Satan, having once got possession, is a tenacious tenant and can not be easily dislodged; and a subsequent proprietor, however pure and pious he may be, will have to suffer the consequences of these sins. Indeed, it is a noteworthy fact that, so long as such a dwelling is occupied by godless persons, the demons are comparatively quiet, the devil recognizing them as his allies and letting them alone; but no sooner does it pass into the possession of a good Christian than "the long-repressed flame of demoniac infes-

tation bursts forth." It therefore behooves purchasers of real estate to ascertain not only that the deed to the property is valid and the conveyance firm in law, but that it is also unencumbered by devils as well as by debts since a Satanic lien may ultimately be the source of greater annoyance than a mortgage or mortmain, or any other sort of legal claim. On this principle, property that has been in the hands of pious people from time immemorial ought to have a higher market value than the dwelling places of the notoriously wicked. Our author thus emphasizes the truth of Holy Writ by showing that not only is "godliness profitable unto all things," but also, as mediæval writers were wont to say, unto some things besides, which the apostle Paul in his admonitions to his "son Timothy" never dreamed of.

Exorcism may be practiced by any regularly consecrated priest with the approval of the diocesan bishop. It is by no means necessary to be a saint in order to possess this power. "Such a demand would be absurd. Saints can not be stamped out of the ground at pleasure, although it would be an excellent thing if all priests were saints. . . . Priestly ordination and a pure life suffice to overcome demons, at least in most cases." But in addition to sacerdotal dignity and personal worthiness certain physical qualities are desirable. A priest who is infirm or prone to melancholy or of a timid disposition ought not to undertake such duties. Strong faith, robust health, moral courage, force of will, and a certain inventive genius in extemporizing expedients within permissible limits are essential to the highest success in coping with devils. "The instructions which precede the *exorcismus ad liberandos obsessos*, in the Roman ritual, leave much to the personal initiative and spontaneity of the exorcist, who, by making a proper use of this freedom, is often able to confuse and conquer the infernal adversary beyond the most sanguine expectation." Dr. Bischofberger gives an example of what can be accomplished by such ingenuity from his own experience. In order to expel the devils from a house in which a murder had been committed fifty years before and gone unpunished, he bored holes in the four corners of the doors, and after filling them with consecrated objects pegged them in. After a time, seeing that this measure had proved ineffectual, he investigated the matter, and found that the pegs had been pulled out and the contents of the holes removed. He then replaced the holy objects, scorched the pegs in the flame of a consecrated candle, dipped them in holy water, and drove them into the holes. This ingenious device threw the devils into the utmost confusion and compelled them to vacate the premises, from which repeated efforts had been made to expel them for more than three months.

Demons are said to watch with lively interest the progress of

modern science and to build great hopes upon it. On one occasion, when the priest came with consecrated oil (*oleum simplex*) and holy water and began to utter the prescribed exorcism, the evil spirit cried out: "Woe is me! I thought that rubbish had long since gone out of vogue and been discarded as dead superstition." In the ages of faith it was customary to cast out devils in the presence of the whole congregation; but, owing to the growth of skepticism even among so-called believers, it is now deemed better to do it *scorsum a multitudine* (apart from the crowd), which would be attracted by idle curiosity rather than by the spirit of devotion. It is desirable, however, that the priest should select from the kinsmen and friends of the energumen a number of pious men who, after confessing and taking the communion, shall sustain him by prayer and fasting. Dr. Bischofberger firmly believes that our insane asylums contain many demoniacs who might be healed by the Church, but whom "science falsely so called" has condemned to the madhouse and the strait-jacket; he condemns the priests who would fain show their enlightenment by indorsing the decisions of the alienist, and exclaims: "O spirit of the age! How strongly hast thou infected even the clergy!" It may also be regarded as a concession to this spirit that it is now admissible to call in a physician in order to repair the damages done by the demon to the bodily organism, whereas in the middle ages, and indeed down to the seventeenth century, the Church positively forbade any such intervention, and maintained that the divine power which cast out the devil would also heal the breach. With the general decline of faith in miracles it is permitted to have recourse to medicine, which, however, must be blessed by a priest before being administered to the patient.

In Italy a priest is usually called in, not only to bless newly erected buildings but also to sprinkle with holy water and to fumigate with incense every house in the octaves of Easter. Dr. Bischofberger regrets that this "laudable custom" does not prevail in Germany, since the old maxim that "an ounce of prevention is worth a pound of cure" applies with peculiar force to the treatment of demonical possession. We are also told that a very disagreeable "*aura corrumpens*" is apt to pervade all dwellings which have been infested for a long time, and that this taint remains many years after the demons have been expelled. A sensitive person can not enter such a house without being seized with dizziness, nausea, or strange nervous sensations which manifest themselves in palpitations of the heart, sudden paleness, and trembling of the limbs. The carnal mind, which is at enmity with all supernatural interpretations of natural phenomena, would suggest that these symptoms indicate inadequate ventilation and would seek relief in opening the windows and letting in fresh

air rather than in aspersions and adjurations and *benedictiones locorum.*

Essentially the same method is to be pursued in freeing stables and cattle from demons, only other formulas of benediction are used, such as the *benedictus stabuli*, or *pabuli*, or *jumentorum*, or *medicinæ pro animalibus*, as the case may be. The first thing to be done is to bore holes in the four corners of the doorcase and to fill them with bits of Easter candles and other consecrated objects. Great efficacy is attributed to this procedure, "since doors have a symbolical significance, on account of which the Jews were commanded to smear the door-posts with the blood of the paschal lamb." Signs of the cross are also to be burned in the hair of the cattle between their horns and in the manes of horses while pronouncing in Latin the words "In the name of the Father, the Son, and the Holy Ghost." Curiously complicated knots and intricate twists and tangles in the hair of animals "are always signs of demoniac infestation." Some eleven years ago the cattle of a peasant in Dr. Bischofberger's parish had their jaws so cramped and contracted that they could hardly eat. The demoniac attack, although severest at feeding time, extended more or less over the whole day and night. If the cows succeeded in getting a little fodder into their mouths, they would keep it there almost motionless for half an hour or more, and only swallow just enough to keep them alive, and after four or five weeks they were all reduced to the verge of starvation. Our learned doctor of divinity then went through with the prescribed benedictions of kine, fodder, stall, etc., as above mentioned, and standing before each animal in turn said, "I command you, demon, in the name of Jesus Christ, the Son of God, that you desist from tormenting this creature of God and no longer disturb it in the exercise of its natural functions." Gradually they began to chew their food slowly, and no sooner was a cross burned in the tuft of hair between the horns than they fell to and ate with a ravenous appetite.

In another case with which he had to deal he found the devil more obstinate. A peasant woman had suffered from various ailments, and after giving birth to a child fell into a state of extreme nervous prostration. The *præceptum probativum* indicated demoniac infestation. By the use of consecrated oil and the proper benedictions the evil spirit was cast out of the woman, but went into the stable, where the cattle became strongly agitated. The bovine benedictions expelled it from the cattle, when it returned to the woman, from whom it passed into her husband and children, but, owing to their good health and bodily soundness, it could find no firm foothold there and was easily driven out, whereupon it went back to the woman and one of the cows. A

veterinarian gave the animal some medicine, which the priest had blessed, and benedictions were pronounced upon the entire building with all its inmates, men and cattle. Shortly afterward it was found that the devil, instead of going back to hell as told to do, had taken up his abode in the well, which was about half a dozen yards from the house, for no sooner did the cows drink the water than their hair bristled and stood on end; also the woman had a relapse after taking a sip of it. Dr. Bischofberger expelled the devil from the well by throwing into it a little consecrated salt, and, after chasing him with the weapons of the Church from one nook and corner to another, finally succeeded in getting rid of him and purgating the whole premises. "We thus see," he concludes, "how the demon makes every effort to deceive, weary, and discourage the officiating priest."

Another important sacerdotal function is the cleansing of milk pails, churns, and other vessels used in the dairy from demoniac infection, which is frequently caused by women touching such vessels during menstruation. However excellent the cream may appear to be, no amount of churning can convert it into butter. In such cases the churn and all the other vessels connected with the dairy should be scalded with hot water and then sprinkled with holy water and dried in the sun, after which it would be well to ward off the possible return of the evil spirit by pronouncing over them the *benedictio ad omnia*. "The hot water removes the natural hindrances and the holy water the demoniac hindrances to the production of butter."

The secret and inexplicable abduction of milk and eggs is also the work of devils. "It is well known," says our author, "that angels, at least some choirs or orders of them, have the power of moving visible objects in an invisible manner from one place to another." Ecclesiastical history, especially in the province of hagiology, contains numerous instances of the exercise of this power. Thus, in 1867, when St. Francisca of the Five Wounds (or Stigmata) was canonized, her claims to sainthood were based in part upon a legend of this kind. It was seriously related on that occasion that while her pastor and confessor, Father Bianchi, was celebrating mass, after the transubstantiation in the eucharist had taken place, the cup suddenly disappeared for a moment and returned to the altar. "This happened repeatedly, and it was subsequently ascertained" (how, we are not informed) "that the archangel Raphael had meanwhile carried the cup to Saint Francisca at times when she would otherwise have had to go without the holy communion." (Leben der Heiligen (Francisca). Mainz: Kirchheim, 1880, pp. 193 *sqq*). It is easy enough to explain how a blear-eyed priest in a dark church might for a minute lose sight of a small object on the altar, such as a goblet or a pyx,

without the intervention of an archangel. Indeed, almost every one has had a similar experience in looking for something on a table or shelf in vain, and then finding it there a few moments later. The momentary oversight may be due to mental abstraction or to a transient visual blur. The angels, we are assured, did not lose by their fall this power of carrying off things invisibly, which therefore remains an attribute of devils, and enables them to indulge their propensity to steal without detection. They sometimes pilfer fruit and grain, but seem to have a special fondness for milk and eggs, a very simple diet, one would think, for infernal spirits. Many persons who keep fowls are often surprised that they do not get any eggs. The hen sits on the nest, lays or at least cackles, but the nest is empty. If such a hen be killed, plenty of eggs in a more or less advanced stage of development will be found in the ovary, and the oviduct will prove to be perfectly healthy and normal. From these facts a strictly logical mind, like that of our learned doctor, can come to only one conclusion: a demon stole the eggs. The same is true of cows, goats, and other lactiferous animals which grow lean and cease to give milk, although they are provided with the most nutritious fodder. "In such cases it is right to assume the workings of witchcraft, and to apply the formula *contra maleficium invisibilis ablationis lactis*, etc., of the Constance Benedictional." In the earlier centuries of the Christian era, before this ritual existed, simpler methods of exorcism were employed and are still effective, such as blessing the stalls, the fodder, and the cows, and washing the teats with holy water, which may be warmed if the animals are sensitive to cold. Snarled tufts of hair or tangles of hemp indicate demonism, and should be thrown into the fire with the words "In the name of the Father, the Son, and the Holy Ghost." Dr. Bischofberger admits that "egg-stealing is more difficult to stop, because the priest has less power over hens." The best remedy is to surround the nests with consecrated things, so that the demon can not get through without coming in contact with them; he will then probably desist. Granaries and fruit lofts are to be protected in the same manner.

In conclusion, the author of this manual of exorcism says, "People fondly imagine that these cunning devices of the Prince of Darkness may have been practiced in former centuries, but that they have been dissipated by the light of the nineteenth century like the mist before the sun." His thirty-seven years' experience as a priest prove this optimistic assumption to be wholly unfounded.

THOMAS HENRY HUXLEY.

By Prof. MICHAEL FOSTER.

TWO scenes in Huxley's life stand out clear and full of meaning amid my recollections of him, reaching now some forty years back. Both took place at Oxford, both at meetings of the British Association. The first, few witnesses of which now remain, was the memorable discussion on Darwin in 1860. The room was crowded though it was a Saturday, and the meeting was excited. The bishop had spoken; cheered loudly from time to time during his speech, he sat down amid rapturous applause, ladies waving their handkerchiefs with great enthusiasm; and in almost dead silence, broken merely by greetings which, coming only from the few who knew, seemed as nothing, Huxley, then well-nigh unknown outside the narrow circle of scientific workers, began his reply. A cheer, chiefly from a knot of young men in the audience, hearty but seeming scant through the fewness of those who gave it, and almost angrily resented by some, welcomed the first point made. Then as, slowly and measuredly at first, more quickly and with more vigor later, stroke followed stroke, the circle of cheers grew wider and yet wider, until the speaker's last words were crowned with an applause falling not far short of, indeed equaling, that which had gone before, an applause hearty and genuine in its recognition that a strong man had arisen among the biologists of England.

The second scene, that of 1894, is still fresh in the minds of all. No one who was present is likely to forget how, when Huxley rose to second the vote of thanks for the presidential address, the whole house burst into a cheering such as had never before been witnessed on any like occasion, a cheering which said, as plainly as such things can say, "This is the faithful servant who has labored for more than half a century on behalf of science with his face set firmly toward truth, and we want him to know that his labors have not been in vain." Nor is any one likely to forget the few carefully chosen, wise, pregnant words which fell from him when the applause died away. Those two speeches, the one long and polemical, the other brief and judicial, show, when taken together, many of the qualities which made Huxley great and strong.

Among those qualities perhaps the most dominant, certainly the most effective as regards his influence on the world, were, on the one hand, an alertness, a quickness of apprehension, and a clear way of thinking, which, in dealing with a problem, made him dissatisfied with any solution incapable of rigid proof and incisive expression; he seemed always to go about with a halo of

clear light immediately around him; and, on the other hand, that power of foreseeing future consequences of immediate action which forms the greater part of what we call sagacity. The former gave him his notable dialectic skill, and mark all his contributions to scientific literature; the latter made him, in addition, an able administrator and a wise counselor, both within the tents of science and beyond. These, at least, were his dominant intellectual qualities; but even more powerful were the qualities in him which, though allied, we distinguish as moral; and perhaps the greater part of his influence over his fellows was due to the fact that every one who met him saw in him a man bent on following the true and doing the right, swerving aside no tittle, either for the sake of reward or for fear of the enemy, a man whose uttered scorn of what was mean and cowardly was but the reciprocal of his inward love of nobleness and courage.

Bearing in mind his possession of these general qualities, we may find the key to the influence exerted by him on biological science in what he says of himself in his all too short autobiographic sketch—namely, that the bent of his mind was toward mechanical problems, and that it was the force of circumstances which, frustrating his boyish wish to be a mechanical engineer, brought him to the medical profession. Probably the boyish wish was merely the natural outcome of an early feeling that the solution of mechanical problems was congenial to the clear, decisive way of thinking, to which I referred above, and which was obviously present even in the boy; and that it was not the subject-matter of mechanical problems, but the mode of treating them which interested him, is shown by the incident recorded by himself, how when he was a mere boy a too zealous attention to a post-mortem examination cost him a long illness. It is clear that the call to solve biologic problems came to him early; it is also clear that the call was a real one; and, as he himself has said, he recognized his calling when, after some years of desultory reading and lonely, irregular mental activity, he came under the influence of Wharton Jones at Charing Cross Hospital. That made him a biologist, but confirmed the natural aptitude of his mind in making him a biologist who, rejecting all shadowy, intangible views, was to direct his energies to problems which seemed capable of clear demonstrable proof. In many respects the biologic problems which lend themselves most readily to demonstrable solutions capable of verification are those which constitute what we call physiology; and if at the time of his youth the way had been open to him, Huxley would probably have become known as a physiologist. But at that time careers for physiologists were of the fewest. His master, Wharton Jones, a physiologist of the first rank, whose work in the first half of this century still re-

mains of classic value, had been driven to earn his bread as an ophthalmic surgeon, and an even greater physiologist, William Bowman, was following the same course. There was no opening in physiology for the young student at Charing Cross, and he was driven by stress of circumstances to morphological rather than to strictly physiological problems; but it was not until long after, when he had achieved eminence as a morphologist, that he finally abandoned his old wish to hold a physiological chair.

Looking back on the past, we may now be glad that circumstances were against his wishes; for (though in every branch of science there is need at all times of a great man) there was at the middle of the century, in the early fifties, a special need in morphology for a man of Huxley's mold. Richard Owen was then dominant, and it is an acknowledged feature of Owen's work that in it there was a sudden leap from most admirable detailed descriptive labor to dubious speculations, based for the most part on, or at least akin to, the philosophy of Oken. Of the "new morphology" in which Johannes Müller was leading the way, and the criteria of which had been furnished by the labors of von Baer, there was then but little in England save, perhaps, what was to be found in the expositions of Carpenter. Of this new morphology, by which this branch of biology was brought into a line with other exact sciences, and the note of which was not to speculate on guiding forces and on the realization of ideals, but to determine the laws of growth by the careful investigation, as of so many special problems, of what parts of different animals, as shown among other ways by the mode of their development, were really the same or alike, Huxley became at once an apostle. His very first work, that on the *Medusæ*, wrought out amid the distractions of ship life, written on a lonely vessel plowing its solitary way amid almost unknown seas, away from books and the communion of his fellow-workers, bears the same marks which characterize his subsequent memoirs; it is the effort of a clear mind striving to see its way through difficult problems, bent on holding fast only to that which could be proved. This is not the occasion to insist in detail on the value of the like morphological work which he produced in the fifties and the sixties, or to show how he applied to other forms of animal life, to echinoderms, to tunicates, to arthropods, to molluscs, and last though not least to vertebrates, the same method of inquiry which guided the work on the *Medusæ*. Nor need I dwell on the many valuable results which he gained for science by attacking in the same spirit the problems offered by the remains of extinct forms. Moreover, he strengthened the effect of his own labors by admirable expositions of the results of others. Further, unlike his great predecessor, who formed no school and had few if any disciples, it was

Huxley's delight to hold out his hand to every young man who he thought could profit by his help, and before many years were over his spirit was moving in the minds of many others. Thus it came about that during the latter half of this century, owing largely to Huxley's own labors and to the influence which he exerted not only in England but abroad, there has been added to science a large body of morphological truths, truths which have been demonstrated and must remain, not mere views and theories which may be washed away.

The excitement of the Darwinian controversy, with its far-reaching issues, has been apt to make us forget how great has been the progress of animal morphology during the past half century. Undoubtedly the solution of special problems touching animal forms, and the great theory of natural selection through the struggle for existence, have been closely bound together: the special learning has furnished support for the general theory, and the general theory, besides strongly stimulating inquiry, has illumined the special problems. But the two stand apart, each on its own basis; and were it possible to wipe out, as with a sponge, everything which Darwin wrote, and which his views have caused to be written, there would still remain a body of science touching animal forms, both recent and extinct, acquired since 1850, of which we may well be proud. In gaining that knowledge Huxley, as well by his own labors as by his influence over others, stands foremost, Gegenbaur being almost his only peer; and had Huxley done nothing more, his name would live as that of one of the most remarkable biologists of the present century.

As we all know, he did much more; his influence on England and on the world went far beyond that of his purely scientific writings. But when we reflect that a hundred years hence the image of the man as he went to and fro among men, so bright and vivid to-day, will have become dim and colorless, a shadow as it were, and that then the man will be judged mainly by the writings which remain, we must count these writings as the chief basis of his fame. And, though we may think it possible that the world of that day, much that is unwritten having been forgotten, may find it in part difficult to understand how great a power Huxley was in his time, the lapse of years will, we may be sure, in no way lessen, it may be will heighten, the estimate of his contributions to exact science.

As we all know, he did much more. To the public outside science he first became known as the bold, outspoken exponent and advocate of Darwin's views, and indeed to some this is still his chief fame. There is no need here to dwell on this part of his work, and I speak of it now chiefly to remark that the zeal with

which he threw himself into this advocacy was merely a part of the larger purpose of his life. Science, or, to use the old phrase of the Royal Society, natural knowledge, had a twofold hold on Huxley. On the one hand, he felt deeply all the purely intellectual and, if we may use the word, selfish joys of fruitful progressive inquiry after truth. This was dominant in his early days, and to it we owe the long list of valuable researches of which I just now spoke, and which followed each other rapidly in the fifties and the sixties. On the other hand, feeling deeply, as he did, his duties as a citizen of the world, science laid hold of him as being the true and sure guide to conduct man in all his ways; and this latter working of science in him, evident even in early days (witness his Address to Workingmen at St. Martin's Hall in 1854), grew stronger and stronger as the years went on, until at last it took almost entire possession of him. To him, indeed, it may be said, science was all in all. He saw, as others see, in science a something which is broadening and strengthening human life by unceasingly bending Nature to the use of man, and making her resources subservient to his desires; he saw the material usefulness of science, but he saw something more. He saw also, as others see, in science a something in which the human mind, exercising and training itself, makes itself at once nimble and strong, and dwelling on which is raised to broad and high views of the nature of things; he saw in science a means of culture, but he saw something more. He saw in science even as it is, and still more in science as it will be, the sure and trustworthy guide of man in the dark paths of life. Many a man of science goes, or seems to others to go, through the world ordering his steps by two ways of thinking. When he is dealing with the matters the treatment of which has given him his scientific position, with physical or with biological problems, he thinks in one way; when he is dealing with other matters, those of morals and religion, he thinks in another way; he seems to have two minds, and to pass from the one to the other according to the subject-matter. It was not so with Huxley. He could not split himself or the universe into two halves, and treat the one and the other half by two methods radically distinct and in many ways opposed; he applied the one method, which he believed to be the true and fruitful one, to all problems without distinction. And as years came over him, the duty of making this view clear to others grew stronger and stronger. Relinquishing, not without bitter regret, little by little, the calm intellectual joys of the pursuit of narrower morphological problems, he became more and more the apostle of the scientific method, driven to the new career by the force of a pure altruism, not loving science the less but loving man the more. And his work in this respect was a double one: he had to teach his scien-

tific brethren, at least his biologic brethren, the ways of science, and he had to teach the world the works of science. It was this feeling which, on the one hand, led him to devote so much labor to the organization of biologic science in order that his younger brethren might be helped to walk in the straight path and to do their work well. It was this feeling, on the other hand, which made him urgent in the spread of the teaching of science. It was this, and no vain love of being known, which led him to the platform and the press. The zeal with which he defended the theory of natural selection came from his seeing the large issues involved; to him the theory was a great example of the scientific method applied successfully to a problem of more than biologic moment; while the fierceness of his advocacy was a natural expression of resentment on the part of one who saw a scientific conclusion, gained with unstinted pains and large reasoning, judged contemptuously by men who knew nothing of science according to methods in which science had no part.

Science, under this aspect, is a part of what is sometimes called philosophy; and though Huxley felt, in common with others, and felt deeply the pleasures of the intellectual wrestler, struggling with problems which, seemingly solved and thrown to the ground, spring up again at once in unsolved strength, it was not these pleasures alone which led him, especially in his later years, to devote so much time and labor to technical philosophic studies. He hoped out of the depths of philosophy to call witnesses to the value of the scientific method. Indeed, nearly all the work of the latter part of his life, including the last imperfect fragment, written when the hand of disease which was to be the hand of death was already laid upon him, and bearing marks of that hand, was wrought with one desire—namely, to show that the only possible solutions of the problems of the universe were such as the scientific method could bring. This was at the bottom of that antagonism to theology which he never attempted to conceal, and the real existence of which no one who wishes to form a true judgment of the man can ignore. He recognized that the only two consistent conceptions of man and the universe were the distinctly theologic one and the scientific one: he put aside as unworthy of serious attention all between. He was convinced that the theologic conception was based on error, and much of his old age was spent in the study of theologic writings whereby he gathered for himself increasing proof that there was no flaw in the judgment which had guided his way from his youth upward. Not only so, but he was no less convinced that, owing to what he believed to be the essential antagonism of the theologic and the scientific methods, the dominance of the former was an obstacle to the progress of the latter. This conviction he freely confessed

to be the cause of his hostile attitude; he believed it to be the justification of even his bitter polemics.

But while on the objective side his scientific mode of thought thus made him a never-failing opponent of theologic thought of every kind, a common tie on the subjective side bound him to the heart of the Christian religion. Strong as was his conviction that the moral no less than the material good of man was to be secured by the scientific method alone, strong as was his confidence in the ultimate victory of that method in the war against ignorance and wrong, no less clear was his vision of the limits beyond which science was unable to go. He brought into the current use of to-day the term "agnostic," but the word had to him a deep and solemn meaning. To him "I do not know" was not a mere phrase to be thrown with a light heart at the face of an opponent who asks a hard question; it was reciprocally with the positive teachings of science the guide of his life. Great as he felt science to be, he was well aware that science could never lay its hand, could never touch, even with the tip of its finger, that dream with which our little life is rounded, and that unknown dream was a power as dominant over him as was the might of known science; he carried about with him every day that which he did not know as his guide of life no less to be minded than that which he did know. Future visitors to the burial place on the northern heights of London, seeing on his tombstone the lines—

> "And if there be no meeting past the grave,
> If all is darkness, silence, yet 'tis rest.
> Be not afraid, ye waiting hearts that weep,
> For God 'still giveth his belovèd sleep,'
> And if an endless sleep he wills—so best"—

will recognize that the agnostic man of science had much in common with the man of faith.

There is still much more to say of him, but this is not the place to say it. Let it be enough to add that those who had the happiness to come near him knew that besides science and philosophy there was room in him for yet many other things; they forgot the learned investigator, the wise man of action, and the fearless combatant as they listened to him talking of letters, of pictures, or of music, always wondering which delighted them most, the sure thrust with which he hit the mark, whatever it might be, or the brilliant wit which flashed around his stroke. And yet one word more. As an object seen first at a distance changes in aspect to the looker-on who draws nearer and yet more near, features unseen afar off filling up the vision close at hand, so he seemed to change to those who, coming nearer and nearer to him, gained a happy place within his innermost circle; his incisive thought, his

wide knowledge, his sure and prompt judgment, his ready and sharp word, all these shrunk away so as to seem but a small part of him; his greater part, and that which most shaped his life, was seen to be a heart full of love, which, clinging round his family and his friends in tenderest devotion, was spread over all his fellow-men in kindness guided by justice.—*Nature.*

PLEASURES OF THE TELESCOPE.

By GARRETT P. SERVISS.

VII.—PISCES, ARIES, TAURUS, AND THE NORTHERN STARS.

THE eastern end of Pisces, represented in map No. 22, includes most of the interesting telescopic objects that the constellation contains. We begin our exploration at the star numbered 55, a double that is very beautiful when viewed with the three-inch glass. The components are of magnitudes five and eight, distance 6·6″, p. 192°. The larger star is yellow and the smaller deep blue. The star 65, while lacking the peculiar charm of contrasted colors so finely displayed in 55, possesses an attraction in the equality of its components which are both of the sixth magnitude and milk-white. The distance is 4·5″, p. 118°. In 66 we find a swift binary whose components are at present far too close for any except the largest telescopes. The distance in 1894 was only 0·36″, p. 329°. The magnitudes are six and seven. In contrast with this excessively close double is ψ, whose components are both of magnitude five and a half, distance 30″, p. 160°. Dropping down to 77 we come upon another very wide and pleasing double, magnitudes six and seven, distance 33″, p. 82°, colors white and lilac or pale blue. Hardly less beautiful is ζ, magnitudes five and six, distance 24″, p, 64°. Finest of all is α, which exhibits a remarkable color contrast, the larger star being greenish and the smaller blue. The magnitudes are four and five, distance 3″, p. 320°. This star is a binary, but the motion is slow. The variable R ranges between magnitudes seven and thirteen, period three hundred and forty-four days.

The constellation Aries contains several beautiful doubles, all but one of which are easy for our smallest aperture. The most striking of these is γ, which is historically interesting as the first double star discovered. The discovery was made by Robert Hooke in 1664 by accident, while he was following the comet of that year with his telescope. He expressed great surprise on noticing that the glass divided the star, and remarked that he had not met with a like instance in all the heavens. His obser-

vations could not have been very extensive or very carefully conducted, for there are many double stars much wider than γ Arietis which Hooke could certainly have separated if he had examined them. The magnitudes of the components of γ are four and four and a half, or, according to Hall, both four; distance 8·5″, p. 180°. A few degrees above γ, passing by β, is a wide double λ, magnitudes five and eight, distance 37″, p. 45°, colors white and lilac or violet. Three stars are to be seen in 14: magnitudes five and a half, ten, and nine, distances 83″, p. 36°, and 106″, p. 278°, colors white, blue, and lilac. The star 30 is a very pretty double, magnitudes six and seven, distance 38·6″, p. 273°. Σ 289 consists of a topaz star combined with a sapphire, magnitudes six and nine, distance 28·5″, p. 0°. The fourth-magnitude star 41 has several faint companions. The magnitudes of two of these are eleven and nine, distances 34″, p. 203°, and 130″, p. 230°. We discover another triple in π, magnitudes five, eight, and eleven, distances 3·24″, p. 122°, and 25″, p. 110°. The double mentioned above as being too close for our three-inch glass is ε, which, however, can be divided with the four-inch, although the five-inch will serve us better. The magnitudes are five and a half and six, distance 1·26″, p. 202°. The star 52 has two companions, one of which is so close that our instruments can not separate it, while the other is too faint to be visible in the light of its brilliant neighbor without the aid of a very powerful telescope.

We are now about to enter one of the most magnificent regions in the sky, which is hardly less attractive to the naked eye than Orion, and which men must have admired from the beginning of their history on the earth, the constellation Taurus (map No. 23). Two groups of stars especially distinguish Taurus, the Hyades and the Pleiades, and both are exceedingly interesting when viewed with the lowest magnifying powers of our telescopes.

We shall begin with a little star just west of the Pleiades, Σ 412, also called 7 Tauri. This is a triple, but we can only see it as a double, the third star being exceedingly close to the primary. The magnitudes are six and a half, seven, and ten, distances 0·3″, p. 216°, and 22″, p. 62°. In the Pleiades we naturally turn to the brightest star η, or Alcyone, famous for having once been regarded as the central sun around which our sun and a multitude of other luminaries were supposed to revolve, and picturesque on account of the little triangle of small stars near it which the least telescopic assistance enables us to see. One may derive much pleasure from a study of the various groupings of stars in the Pleiades. Photography has demonstrated, what had long been suspected from occasional glimpses revealed by the telescope, that this celebrated cluster of stars is intermingled with curious forms of nebulæ. The nebulous matter appears in festoons, apparently

attached to some of the larger stars, such as Alcyone, Merope, and Maia, and in long, narrow, straight lines, the most remarkable of which, a faintly luminous thread starting midway between Maia

MAP No. 22.

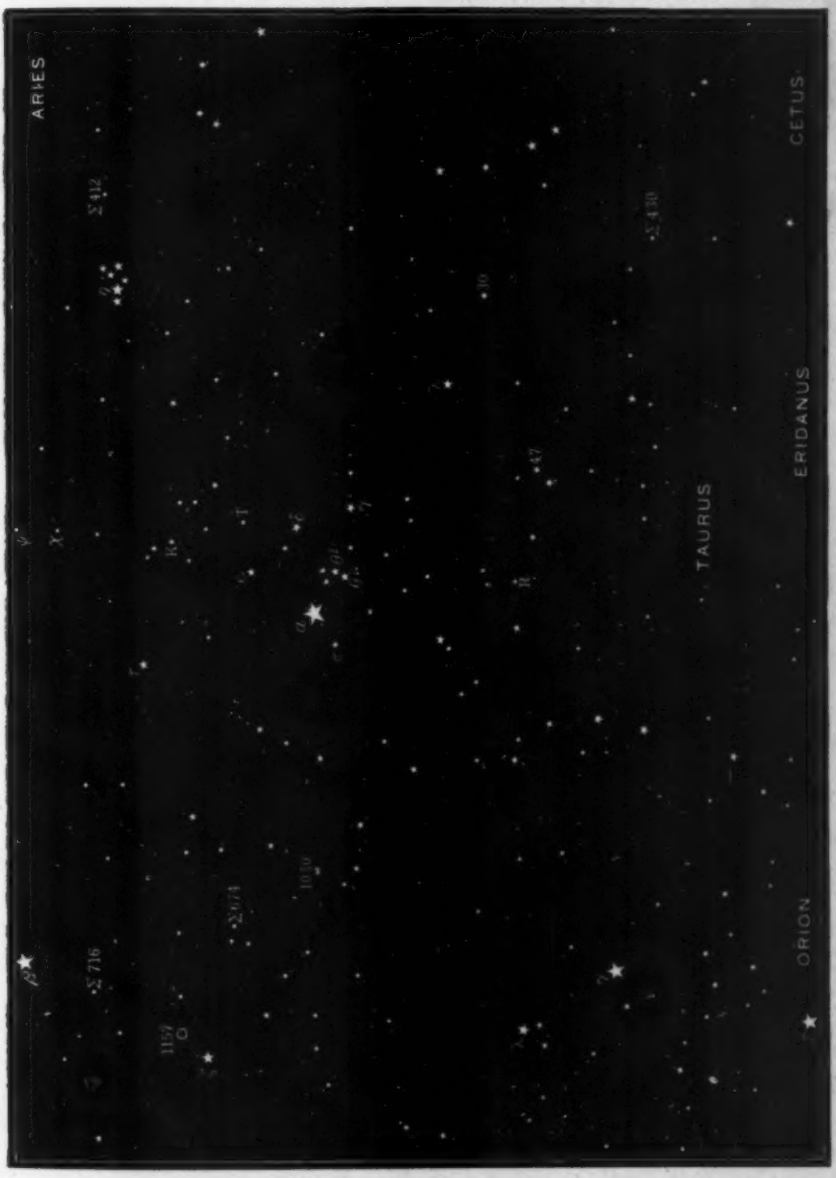
and Alcyone and running eastward some 40′, is beaded with seven or eight stars. The width of this strange nebulous streak is, on an average, 3″ or 4″, and there is, perhaps, no more wonderful phenomenon anywhere in celestial space. Unfortunately, no tele-

scope is able to show it, and all our knowledge about it is based upon photographs. It might be supposed that it was a nebulous disk seen edgewise, but for the fact that at the largest star involved in its course it bends sharply about 10° out of its former direction, and for the additional fact that it seems to take its origin from a curved offshoot of the intricate nebulous mass surrounding Maia. Exactly at the point where this curve is transformed into a straight line shines a small star! In view of all the facts the idea would not seem to be very far-fetched that in the Pleiades we behold an assemblage of suns, large and small, formed by the gradual condensation of a nebula, and in which evolution has gone on far beyond the stage represented by the Orion nebula, where also a group of stars may be in process of formation out of nebulous matter. If we look a little farther along this line of development, we may perceive in such a stellar assemblage as the cluster in Hercules, a still later phase wherein all the originally scattered material has, perhaps, been absorbed into the starry nuclei.

The yellow star Σ 430 has two companions: magnitudes six, nine, and nine and a half, distances 26″, p. 55°, and 39″, p. 302°. The star 30 of the fifth magnitude has a companion of the ninth magnitude, distance 9″, p. 58°, colors emerald and purple, faint. An interesting variable, of the type of Algol, is λ, which at maximum is of magnitude three and four tenths and at minimum of magnitude four and two tenths. Its period from one maximum to the next is about three days and twenty-three hours, but the actual changes occupy only about ten hours, and it loses light more swiftly than it regains it. A combination of red and blue is presented by φ (mistakenly marked on map No. 23 as ψ). The magnitudes are six and eight, distance 56″, p. 242°. A double of similar magnitudes is χ, distance 19″, p. 25°. Between the two stars which the naked eye sees in κ is a minute pair, each of less than the eleventh magnitude, distance 5″, p. 324°. Another naked-eye double is formed by θ^1 and θ^2, in the Hyades. The magnitudes are five and five and a half, distance about 5′ 37″.

The leading star of Taurus, Aldebaran (α), is celebrated for its reddish color. The precise hue is rather uncertain, but Aldebaran is not orange as Betelgeuse in Orion is, and no correct eye can for an instant confuse the colors of these two stars, although many persons seem to be unable to detect the very plain difference between them in this respect. Aldebaran has been called "rose-red," and it would be an interesting occupation for an amateur to determine, with the aid of some proper color scale, the precise hue of this star, and of the many other stars which exhibit chromatic idiosyncrasy. Aldebaran is further interesting

as being a standard first-magnitude star. With the four-inch glass we see without difficulty the tenth-magnitude companion following Aldebaran at a distance of 114″, p. 35°. There is an



Map No. 23.

almost inexplicable charm about these faint attendants of bright stars, which is quite different from the interest attaching to a close and nearly equal pair. The impression of physical relationship is never lacking though it may be deceptive, and this

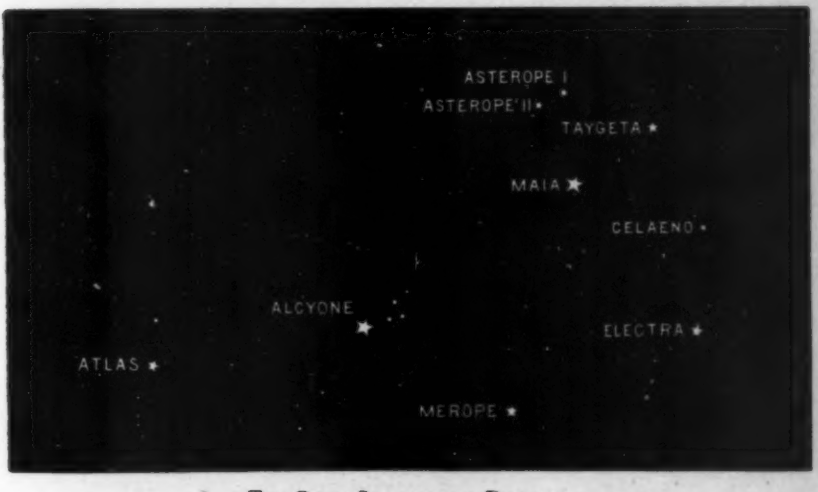
awakens a lively appreciation of the vast differences of magnitude that exist among the different suns of space.

The actual size and might of this great red sun form an attractive subject for contemplation. As it appears to our eyes Aldebaran gives one twenty-five-thousand-millionth as much light as the sun, but if we were placed midway between them the star would outshine the sun in the ratio of not less than 160 to 1. And yet, gigantic as it is, Aldebaran is possibly a pygmy in comparison with Arcturus, whose probable dimensions were discussed in the chapter relating to Boötes. Although Aldebaran is known to possess several of the metallic elements that exist in the sun, its spectrum differs widely from the solar spectrum in some respects, and more closely resembles that of Arcturus.

Other interesting objects in Taurus are σ, divisible with the naked eye, magnitudes five and five and a half, distance 7′; Σ 674 double, magnitudes six and nine, distance 10·5″, p. 147°; Σ 716, double, magnitudes six and seven, distance 5″, p. 200°, a pleasing sight; τ, triple, magnitudes four, ten and a half, and eleven, distances 36″, p. 249°, and 36″, p. 60°. The ten-and-a-half-magnitude star is itself double, as discovered by Burnham; star cluster No. 1030, not quite as broad as the moon, and containing some stars as large as the eleventh magnitude; and nebula No. 1157, the so-called "Crab nebula" of Lord Rosse, which our glasses will show only as a misty patch of faint light, although large telescopes reveal in it a very curious structure.

We now turn to the cluster of circumpolar constellations sometimes called the Royal Family, in allusion to the well-known story of the Ethiopian king Cepheus and his queen Cassiopeia, whose daughter Andromeda was exposed on the seashore to be devoured by a monster, but who was saved by the hero Perseus. All these mythologic personages are represented in the constellations that we are about to study. We begin with Andromeda (map. No. 24). The leading star α marks one corner of the great square of Pegasus. The first star of telescopic interest that we find in Andromeda is μ, a double difficult on account of the faintness of the smaller component. The magnitudes are four and eleven, distance 49″, p. 110°. A few degrees north of μ the naked eye detects a glimmering point where lies the Great Nebula in Andromeda. This is indicated on the map by the number 116. With either of our three telescopes it is an interesting object, but of course it is advisable to use our largest glass in order to get as much light as possible. All that we can see is a long, shuttle-shaped nebulous object, having a brighter point near the center. Many stars are scattered over the field in its neighborhood, but the nebula itself, although its spectrum is peculiar in resembling that of a faint star, is evidently a gaseous or at any rate a meteoritic mass, since

photographs show it to be composed of a series of imperfectly separated spirals surrounding a vast central condensation. This peculiarity of the Andromeda nebula, which is invisible with telescopes although conspicuous in the photographs, has, since its discovery a few years ago, given a great impetus to speculation concerning the transformation of nebulæ into stars and star clusters. No one can look at a good photograph of this wonderful phenomenon without noticing its resemblance to the ideal state of things which, according to the nebular hypothesis, must once have existed in the solar system. It is to be remembered, however, that there is probably sufficient material in the Andromeda nebula to make a system many times, perhaps hundreds or

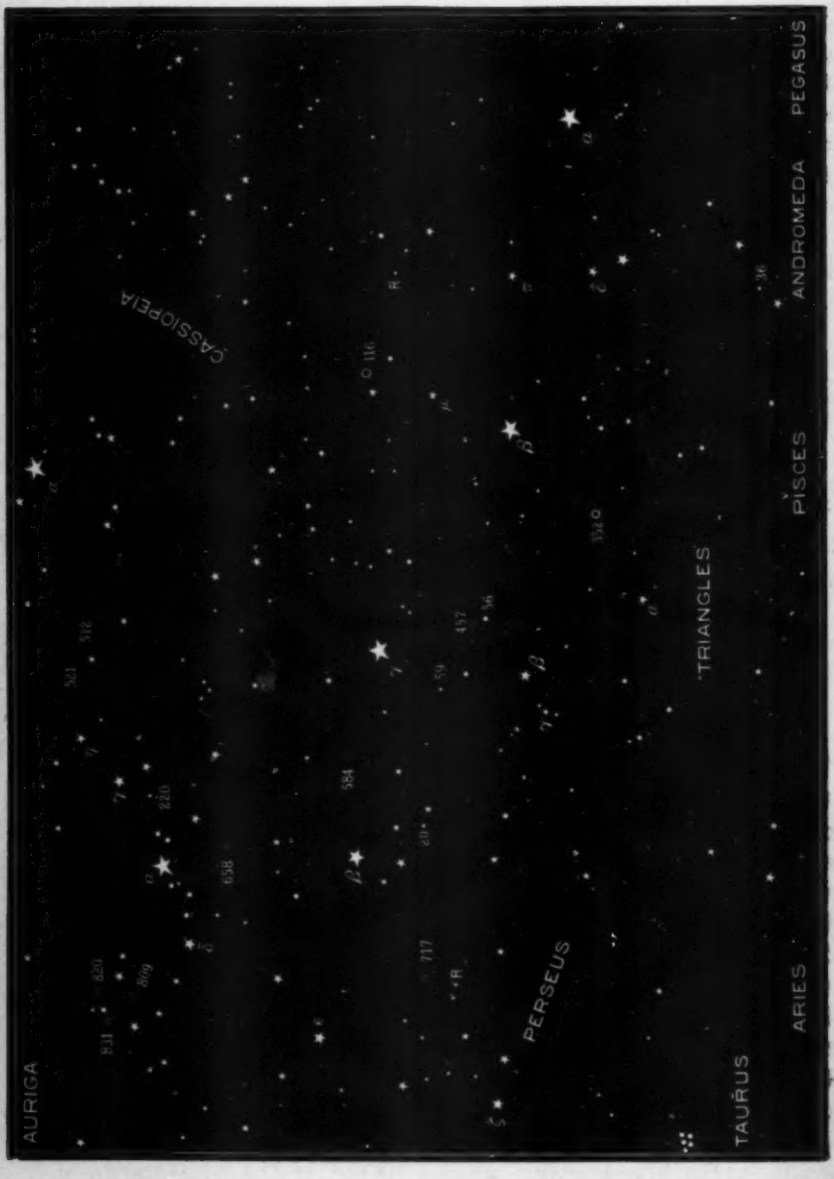


THE CHIEF STARS IN THE PLEIADES.

thousands of times, as extensive as that of which our sun is the center. If one contemplates this nebula only long enough to get a clear perception of the fact that creation was not ended when, according to the Mosaic history, God, having in seven days finished "the heavens and the earth and all the host of them," rested from all his work, a good blow will have been dealt for the cause of truth. Systems far vaster than ours are now in the bud, and long before they have bloomed, ambitious man, who once dreamed that all these things were created to serve him, will probably have vanished with the extinguishment of the little star whose radiant energy made his life and his achievements briefly possible.

In August, 1885, a new star of magnitude six and a half made its appearance suddenly near the center of the Andromeda nebula. Within one year it had disappeared, having gradually dwindled until the great Washington telescope, then the largest in use, no longer showed it. That this was a phenomenon con-

nected with the nebula is most probable, but just what occurred to produce it nobody knows. The observed appearances might have been produced by a collision, and no better hypothesis has yet been suggested to account for them.



Map No. 24.

Near the opposite end of the constellation from α we find the most interesting of triple stars in γ. The two larger components of this beautiful star are of magnitudes three and six, distance

10″, colors golden yellow and deep blue. The three-inch shows them finely. The smaller star is itself double, its companion being of magnitude eight, distance when discovered in 1842 0·5″, color bluish green. A few years ago this third star got so close to its primary that it was invisible even with the highest powers of the great Lick telescope, but at present it appears to be widening again. In October, 1893, I had the pleasure of looking at γ Andromedæ with the Lick telescope, and at that time it was possible just to separate the third star. The angle seemed too small for certain measurement, but a single setting of the micrometer by Mr. Barnard, to whose kindness I was indebted for my view of the star, gave 0·17″ as the approximate distance. The brilliance of color contrast between the two larger stars of γ Andromedæ is hardly inferior to that exhibited in β Cygni, so that this star may be regarded as one of the most picturesque of stellar objects for small telescopes.

Other pleasing objects in this constellation are the binary star 36, magnitudes six and six and a half, distance 1″, p. 12°. The two stars are slowly closing and the five-inch glass is required to separate them: the richly colored variable R, which fades from magnitude five and a half to invisibility, and then recovers its light in a period of about four hundred and five days; and the bright star cluster 457, which covers a space about equal to the area of the full moon.

Just south of the eastern end of Andromeda is the small constellation Triangulum, or the Triangles, containing two interesting objects. One of these is the beautiful little double 6, magnitudes five and six, distance 3·8″, p. 77°, colors yellow and blue; and the other, the nebula 352, which equals in extent the star cluster in Andromeda described above, but nevertheless appears very faint with our largest glass. Its faintness, however, is not an indication of insignificance, for to very powerful telescopes it exhibits a wonderful system of nuclei and spirals—another bit of chaos that is yielding by age-long steps to the influence of demiurgic forces.

A richer constellation than Andromeda, both for naked-eye and telescopic observation, is Perseus, which is especially remarkable for its star clusters. Two of these, 512 and 521, constitute the celebrated double cluster, sometimes called the Sword-hand of Perseus, and also χ Persei. To the smallest telescope this aggregation of stars, ranging in magnitude from six and a half to fourteen, and grouped about two neighboring centers, presents a marvelous appearance. As a striking object for an eye unaccustomed to celestial observations it may be compared among star clusters to β Cygni among double stars, for the most indifferent spectator wonders at it. All the other clusters in Perseus

represented on the map are worth examining, although none of them calls for special mention, except perhaps 584, where we may distinguish at least a hundred separate stars within an area less than one quarter as expansive as the face of the moon.

Among the double stars of Perseus we note first η, whose components are of magnitudes four and eight, distance 28″, colors white and pale blue. The double ϵ is especially interesting on account of an alleged change of color from blue to red which the smaller star undergoes coincidently with a variation of brightness. The magnitudes are three and eight, distance 9″, p. 9°. An interesting multiple is ζ, two of whose stars at least we can see. The magnitudes are three, nine, ten, and ten, distances 13″, p. 207°, 90″, and 112″.

The chief attraction in Perseus is the changeful and wonderful β, or Algol, the great typical star among the short-period variables. During the greater part of its period this star is of magnitude two and two tenths, but for a very short time, following a rapid loss of light, it remains at magnitude three and seven tenths. The difference, one magnitude and a half, corresponds to an actual difference in brightness in the ratio of 3·75 to 1. The entire loss of light during the declension occupies only four hours and a half. The star remains at its faintest for a few minutes only before a perceptible gain of light occurs, and the return to maximum is as rapid as was the preceding decline. The period from one minimum to the next is two days twenty hours forty-eight minutes fifty-three seconds, with an irregularity amounting to a few seconds in a year. The Arabs named the star Algol, or the Demon, on account of its eccentricity which did not escape their attention; and when Goodricke, in 1782, applied a scientific method of observation to it, the real cause of its variations was suggested by him, but his explanation failed of general acceptance until its truth was established by Prof. E. C. Pickering in 1880. This explanation gives us a wonderful insight into stellar constitution. According to it, Algol possesses a companion as large as the sun, but invisible, both because of its proximity to that star and because it yields no light, and revolving in a plane horizontal to our line of sight. The period of revolution is identical with the period of Algol's cycle of variation, and the diminution of light is caused by the interposition of the dark body as it sweeps along that part of its orbit lying between our point of view and the disk of Algol. In other words, once in every two days twenty hours and forty-nine minutes Algol, as seen from the earth, undergoes a partial eclipse.

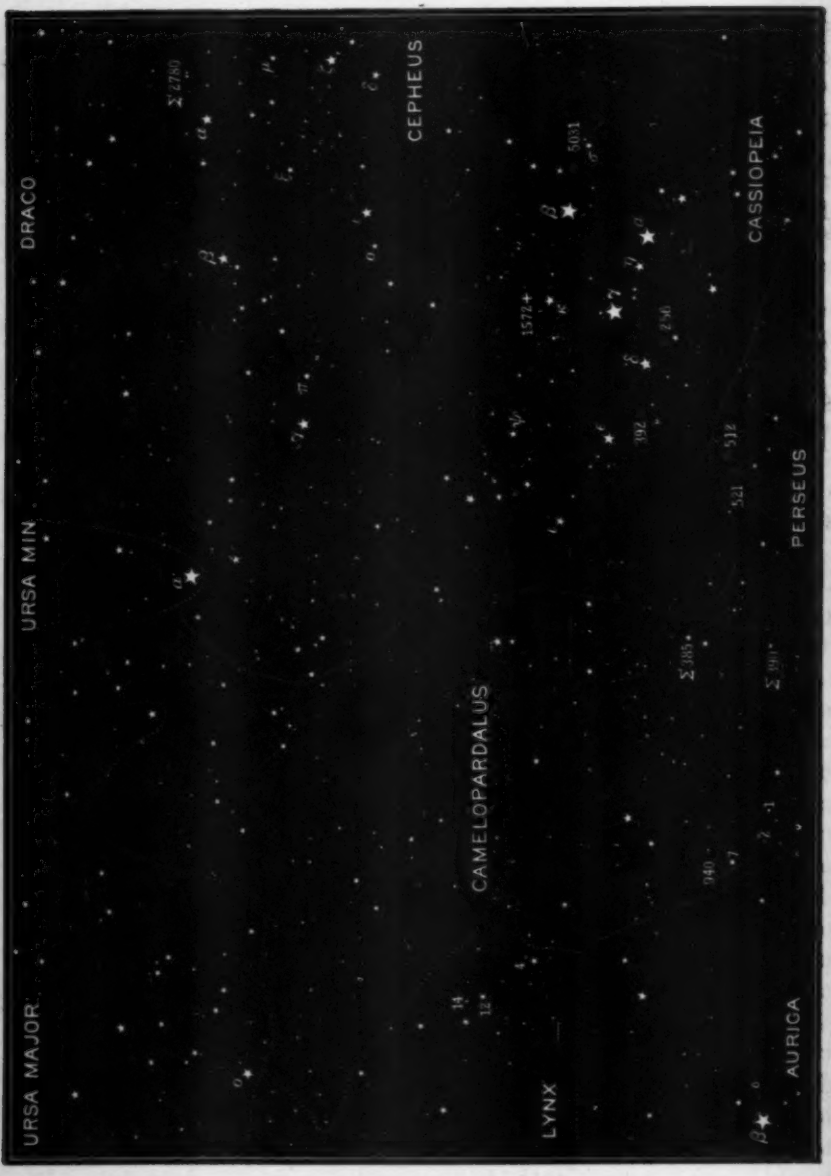
In consequence of the great comparative mass of its dark companion, Algol itself moves in an orbit around their common center with a velocity quite sufficient to be detected by the shifting

of the lines in its spectrum. By means of data thus obtained the mass, size, and distance apart of Algol and its singular comrade have been inferred. The diameter of Algol is believed to be about 1,125,000 miles, that of the dark body about 840,000 miles, and the mean distance from center to center 3,230,000 miles. The density of both the light and the dark star is slight compared with that of the sun, so that their combined mass is only two thirds as great as the sun's.

Mention has been made of a slight irregularity in Algol's period of variation. Basing his calculations upon this inequality Dr. Chandler has put forward the hypothesis that there is another invisible body connected with Algol, and situated at a distance from it of about 1,800,000,000 miles, and that around this body, which is far more mssive than the others, Algol and its companions revolve in a period of one hundred and thirty years! Dr. Chandler has earned the right to have his hypotheses regarded with respect, even when they are as extraordinary as that which has just been described. It needs no indulgence of the imagination to lend interest to Algol; the simple facts are sufficient. How did that bright star fall in with its black neighbors? Or were they created together?

Passing to the region covered by map No. 25, our eyes are caught by the curious figure, formed by the five brightest stars of the constellation Cassiopeia, somewhat resembling the letter W. Like Perseus, this is a rich constellation, both in star clusters and double stars. Among the latter we select as our first example σ, in which we find a combination of color that is at once very unusual and very striking—green and blue. The magnitudes are five and seven, distance 3″, p. 324°. Another beautiful colored double is η, whose magnitudes are four and seven and a half, distance 5″, p. 200°, colors white and purple. This is one of the comparatively small number of stars the measure of whose distance has been attempted, and a keen sense of the uncertainty of such measures is conveyed by the fact that authorities of apparently equal weight place η Cassiopeiæ at such discordant distances as 124,000,000,000,000 miles, 70,000,000,000,000 miles, and 42,000,000,000,000 miles. It will be observed that the difference between the greatest and the least of these estimates is about double the entire distance given by the latter. The same thing practically is true of the various attempts to ascertain the distance of the other stars which have a perceptible parallax, even those which are evidently the nearest. In some cases the later measures increase the distance, in other cases they diminish it; in no case is there anything like a complete accord. Yet of course we are not to infer that it is hopeless to learn anything about the distances of the stars. With all their uncertainties and

disagreements the few parallaxes we possess have laid a good foundation for a knowledge of the dimensions of at least the nearer parts of the universe.



Map No. 26.

We find an interesting triple in ψ, the magnitudes of the larger components being four and a half and eight and a half, distance 30″. The smaller star has a nine-and-a-half-magnitude companion, distance 3″. A more beautiful triple is ι, magnitudes

four, seven, and eight, distances 2″, p. 256°, and 7·5″, p. 112°. Cassiopeia contains many star clusters, three of which are indicated in the map. Of these 392 is perhaps the most interesting, as it contains stars of many magnitudes, including a red one of the eighth magnitude, and a ninth-magnitude double whose components are 8″ apart. Not far from the star κ we find the spot where the most brilliant temporary star on record made its appearance on November 11, 1572. Tycho Brahe studied this phenomenon during the entire period of its visibility, which lasted until March, 1574. It burst out suddenly with overpowering splendor, far outshining every fixed star, and even equaling Venus at her brightest. In a very short time it began to fade, regularly diminishing in brightness, and at the same time undergoing changes of color, ending in red, until it disappeared. It has never been seen since, and the suspicion once entertained that it was a variable with a period considerably exceeding three hundred years has not been justified. There is a tenth-magnitude star near the place given by Tycho as that occupied by the stranger. Many other faint stars are scattered about, however, and Tycho's measures were not sufficiently exact to enable us to identify the precise position of his star. If the phenomenon was due to a collision, no reappearance of the star is to be expected.

Camelopardalus is a very inconspicuous constellation, yet it furnishes considerable occupation for the telescope. Σ 390, of magnitude five, has a companion of magnitude nine and a half, distance 15″, 160°. Σ 385, also of the fifth magnitude, has a ninth-magnitude companion, distance only 2·4″, p. 160°. According to some observers, the larger star is yellow and the smaller white. The star I is a very pretty double, magnitudes both six, distance 10·4″. Its neighbor 2 of magnitude six has an eighth-magnitude companion, distance 1·7″, p. 278°. The star 7 of magnitude five is also double, the companion of magnitude eight being distant only 1·2″. A glance at star cluster 940, which shows a slight central condensation, completes our work in Camelopardalus, and we turn to Ursa Major, represented in map No. 26. Here there are many interesting doubles and triples. Beginning with ι we find at once occupation for our largest glass. The magnitudes are three and ten, distance 10″, p. 357°. In the double star 23 the magnitudes are four and nine, distance 23″, p. 272°. A more pleasing object is σ^2, a greenish fifth-magnitude star which has an eighth-magnitude companion, distance 2·6″, p. 245°. A good double for our four-inch glass is ξ, whose magnitudes are four and five, distance 1·87″, p. 183°. This is a binary with a period of revolution of about sixty years, and is interesting as the first binary star whose orbit was determined. Savary calculated it in 1828. Near by is ν, a difficult double, magnitudes four and ten and

a half, distance 7″, p. 147°. In 57 we find again an easy double magnitudes six and eight, distance 5·5″, p. 4°. Another similar

Map No. 26.

double is 65, magnitudes six and eight, distance 3·9″, p. 38°. A third star, magnitude seven, is seen at a distance of 114″ from the primary.

We come now to Ursa Major's principal attraction ζ, frequently called Mizar. The naked eye perceives near it a smaller star, called Alcor. With the three-inch glass and a medium power we divide Mizar into two bright stars brilliantly contrasted in color, the larger being white and the smaller blue-green. Beside Alcor, several fainter stars are seen scattered over the field of view, and, taken all in all, there are very few equally beautiful sights in the starry heavens. The magnitudes of the double are three and four, distance 14·5″, p. 148°. The large star is again double, although no telescope has been able to show it so, its duplicity being revealed, like that of β Aurigæ, by the periodical splitting of the lines in its spectrum.

Ursa Major contains several nebulæ which may be glimpsed with telescopes of moderate dimensions. An interesting pair of these objects, both of which are included in one field of view, is formed by 1949 and 1950. The first named is the brighter of the two, its nucleus resembling a faint star. The nebula 2343 presents itself to us in the form of a faint, hazy star, but with large telescopes its appearance is very singular. According to a picture made by Lord Rosse, it bears no little resemblance to a skull, there being two symmetrically placed holes in it, each of which contains a star.

The portion of Canes Venatici, represented in map No. 26, contains two or three remarkable objects. Σ 1606 is a close double, magnitudes six and seven, distance 1″, p. 336°. It is a pretty sight with the five-inch. The double star 2 is singular in that its larger component is red and its smaller blue; magnitudes six and eight, distance 11·4″, p. 260°. Still more beautiful is 12, commonly called Cor Caroli. This double is wide, and requires but a slight magnifying power. The magnitudes are three and six, distance 20″, colors white or light yellow and blue. The nebula 3572, although we can see it only as a pair of misty specks, is in reality a very wonderful object. Lord Rosse's telescope has revealed in it a complicated spiral structure, recalling the photographs of the Andromeda nebula, and indicating that stupendous changes must be in process within it, although our records of observation are necessarily too brief to bring out any perceptible alteration of figure. It would seem that the astronomer has, of all men, the best reasons for complaining of the brevity of human life.

Lastly, we turn to Ursa Minor and the Pole Star. The latter is a celebrated double, not difficult, except with a telescope of less than three inches aperture in the hands of an inexperienced observer. The magnitudes are two and nine, distance 18·5″. The small star has a dull blue color. In π′ we discover a wide double, magnitudes six and seven, distance 30″, p. 83°.

This completes our survey of the starry heavens.

THE LIFE OF WATER PLANTS.

By M. BÜSGEN.

WHEN we mentally survey the floral dress that variegates the solid crust of our globe, the world of plants appears to be divided into a few large groups. We think of the primitive forest with its mossy trees, the slender vines, and the multiform beauties of the orchids; the steppe comes to our minds with its hard, sharp-cutting grasses; and the moist carpeting of the Alpine flora, with gentian and fragrant herbs. The eye lingers longest on the native group; the colored population of our meadows rises before us, the forest with its berried undergrowth, and possibly the bushy river bank and the undulating insulated plant-covering of a pond. Each of the plant groups we have named bears a special expression distinguishing it from all the others. The members of each have certain common features the aggregation of which constitutes the characteristic of the group. In them are included plants which are not at all connected by natural relationship. Ivy is not related to wintergreen or the strawberry to the huckleberry, and all these, again, are far removed from ferns, mosses, and fungi; yet we are satisfied as to the connection of these plants, so that we regard them as members of a definite group, as is represented by our wood flora. So with the other forms we have named, those of the tropical forest, of the steppe, and of the Alpine fields; the plants constituting them are not grouped by blood relationship. Outer circumstances, the conditions of life, have impressed their special characters upon them. The shadow of the wood, the tropical rains, the short summer of the Alps, the aridity of the steppe—all these are factors which have produced in the plants exposed to them common properties more perceived than defined, because they have had effect upon their outer figure as well as upon their vital processes. Thus these groups of plants are developed by the community of their life conditions. They furnish illustrations of Goethe's saying that the manner of life works powerfully on all forms.

We shall study more closely in this paper one of these communities of life conditions—the plant world of the water—and inquire into the connection existing between its most marked peculiarities and the conditions of life afforded by the water. If we walk along the shore of a large pond sheltering a rich growth of plants, or of a bush-lined stream, the vegetable inhabitants will be divided, at first sight, into three groups—the shore plants on the banks; the floating leaves and flowers of the surface plants; and in the depths, hardly visible to the eye, the submerged flora, composed of a few curiously shaped flowering plants, and many

of the lower orders belonging for the most part to the little microscopic world. The shore plants form a transition class between the vegetation of the land and that of the water. Taking root in damp soils, or perhaps under water, they lift the greater part of their stems with their leaves and flowers above the surface, joining the land flora in their methods of growing, respiring, and feeding. Among the shrubbery of the meadow, overtopped by single gray-stemmed alders, rise little forests of rustling reeds, both interspersed with variegated masses of various herbs, among which sharp-edged sedges and round-stalked rushes take the first places, by the side of the fragrant calamus, irises, and the umbel-flowers of the tall water violets. Farther ashore rise the beautiful white panicles of the swamp meadowsweet, with the grayish-green leaves and violet flowers of the bittersweet. We must not overlook the white stars of the willow-leaved aster, signs of the beginning of autumn, and the great bindweed, whose threadlike stems find welcomed support on the hard stalks of the reeds. Altogether a variegated picture, the characteristic points of which are hard to separate from the impression of the whole. This is easier to do with two other forms of shore flora which have been developed under peculiar conditions furnished by our waters—the flora of the sandy sea-beaches and that of the unfathomable, unstable morasses of the mouths of tropical rivers. In the former instance a striking appearance is given to the vegetation by the salt contained in the soil. Plants with usually inconspicuous flowers, and also a pretty blue aster, have adapted themselves to life by the salt water. They are sometimes distinguished by their fleshy leaves, the properties of which stand in so close relation to the presence of salt in their habitat that when one is far from the sea he can judge by their presence whether there is salt in the soil.

Characteristic of the tropical morasses are the mangroves, a group of arborescent plants which stand as if on stilts on long, bracing roots sent out from all parts of their stems. The young shoots are hard, dagger-shaped bodies about a metre long, which finally drop down and bore perpendicularly into the slime so that they shall not be disturbed by the current, and may become fixed in the mud. In both of these shore regions the special forms appear to be developed in connection with the peculiar features of the locality.

These adaptations to special conditions thus easily recognized in the shore vegetation are greatly multiplied in the water plants proper. The better to understand them, we must, before going into particulars, devote a few words to the origin of the water flora. Among them are representatives of various orders and classes. They may be divided into plants that have strayed from the land into the water, and those whose original home is that

element. The doctrine of the Greek philosophers, that everything is derived from water, is so far correct for the vegetable world that the first plants that appeared on the earth were water plants. There were probably little microscopic forms inhabiting the barely cooled waters of the primitive seas before there was any land to afford a suitable home for any living beings—formless albuminous masses, like "organisms without organs," which, like some of the bacteria, drew their food from the dead stone. Like their living kindred, the lower *Algæ*, they were of too tender nature to be preserved in the cavities of the sea slime. The first remains seemingly of vegetable character preserved in the oldest strata of the earth's crust are therefore of relatively large fucoids. Their existence justifies our supposing an already richly developed flora of *Algæ* such as is now found in the deepest parts of our lakes. Mosses, ferns, and flowering plants are absent. They appear later, and under conditions which prove that they were produced not in the sea but on swampy land. Geological evidence shows us that only the *Algæ* and the fucoids originated in water and were water plants from the first. The other water plants, especially flowering plants growing in water, were driven into the water by increasing competition among the growing number and variety of the land plants, and assumed the properties that now distinguish them from land plants during their compulsory emigration, and in consequence of their water life. This process is now going on in our sight in a certain plant—the wandering knotgrass—a relative of the small-flowered, spreading swine grass and of the adderwort. This plant grows on the borders of ditches and ponds, often half on land and half in the water; and it can not escape the attentive observer that it presents a quite different appearance in the water from that upon land. Stiffly haired, and having short-stemmed leaves on land, it is in water bald and smooth, and develops very long leafstalks which terminate on the surface in flat, floating expansions. Here there is a plant which only occasionally, and usually only partly, makes its home in the water, and is in a position to suffer such remarkable changes that it is no longer a wonder that plants which have become entirely at home in the water are very little like those of their genus which remain land plants. Of many of them, in fact, it can no longer be determined from what family of land plants they are really derived. Even such well-defined plants as seaweed and duckweed would not at first sight suggest to any one relationship with the *Arum* family. So with the water crowfoot, which we shall take as our starting point in the discussion of the properties of water plants. Well known are its little white flowers, which adorn the ponds and even the swift streams in the summer time.

These little blossoms, thickly massed on the surface of the water, or sitting on long stems, spread out their five petals, which, with their numerous stamens and styles, mark them as relatives of the buttercups. In the other parts we look vainly for resemblances with the ranunculuses. If, for instance, we take one of them which we find floating in running water, out of its element, the whole plant falls together, and we hold in our hand nothing but a bunch of long threads, in which no difference can be perceived between stems and leaves. If we spread a part of the bunch upon a stone, we may discover branching shoots beset with leaf forms; but both organs are widely different from those of their nearest generic relatives. The stems of the ranunculuses of the fields are upright, stiff, skeleton-like, strong enough to defy wind and storm, and able to bear the weight of their leaves, flowers, and fruits. The stems of the water ranunculuses are slack and weak. They are swung around helplessly by the waves, winding hither and thither in the direction toward which the run of the stream carries them. They are stable only in the direction of their length, because in any other case the current would carry them away. In other respects the stem does need cohesive power. The whole plant is pierced with connected air passages, and all its parts are adapted to floating or swimming. The water here takes the burden upon itself which is imposed on the stems of land plants. Floating plants need no skeletons; and dissection and microscopic examination show that all those forms are wanting in their interiors which, like the bones of animals, give stability and tenacity to their structure.

Many water plants lack organs still more closely associated with the life processes. We can not conceive of a higher animal without veins and lymph-vessels. But in water plants we not seldom miss the long and broad ducts of which the vascular system of land plants is constituted. At all events the vessels do not perform so important a part in the vegetable kingdom as the circulation of the life juices in the animal kingdom. Their principal service is to carry water from the roots to the leaves. From this we can understand how organs essential to the life of land plants can be dispensed with in water plants. They do not need a special conducting of water, because they are surrounded by that element on every side. The most marked instance of the absence of internal organs is met in an alga which forms green fields in the deeper parts of the Mediterranean Sea. It has slender, branching, horizontally creeping stems which develop above in the water into leaves and below in the sand into fine thread roots. But the whole plant, often many feet in length, consists only of single gigantic cells. A tough skin incloses its juices, which flow in a continuous stream through the stem, leaves, and roots of the

curious growth, here taking up through the skin and assimilating mineral substances, there producing and transforming organic matter, and at the same time advancing the growth and increase of the whole. Not less peculiar than the inner structure and appearance of the stem is the form of the leaves of water plants. Their service to the organism is the same with that of the leaves of other plants. They supply, with the help of the sunlight, matter which the plant needs for building up its body. The conditions under water are not very favorable for this work, for the rays of light suffer considerable loss of intensity in passing through even a thin sheet of water. In connection with this there are leaves growing under the water, as in the floating crowfoot, as a rule not flat or oval or cordate or round, like most other kinds of leaves, but divided into the thinnest threadlike strips, which, with the largest surface development, obstruct the least possible light from one another and easily yield to the current.

The leaves that are destined to live on top of the water are otherwise constructed. They will not overshadow one another, and they are exposed to the full light of the sun. They need only to receive it on as broad a surface as possible, and so to float that the weight of the food-stuff accumulated within them all the day long shall not cause them to be submerged. These leaves consequently do not present divisions or ramifications like the leaves of roses and acacias. They form reniform or oval disks, which lie flat upon the water. Every one will recollect this who has seen the yellow and the white pond lilies. The brownish spawn weed and the beautiful white flowing frog spittle likewise have swimming leaves; and there is a marsh crowfoot which has these and submerged threaded leaves all on the same stalk. In the duckweeds stem and leaf are not distinguished, and the plant is only a flat disk with a few insignificant rootlets on the under side; and in one species these are wanting. The plant is only a little floating leaf, with a pocket for the reception of the scantily endowed flowers.

The floating leaves of the Victoria Regia are beautifully developed. They have the form of flat plates with a narrow, upturned border—a form more favorable to their flotation. The green leaves, a yard or more across, with the pink flowers resembling gigantic lilies scattered among them, present a remarkable spectacle.

One of the most remarkable peculiarities of the floating leaves of our water plants is that they never grow up above the surface of the water. The plant appears to know when that point is reached. As we shrink from sudden contact with cold water, these leafstalks suspend their growth on contact with the air. They grow just long enough for the leaf expansion to reach the

surface of the water. There it unfolds itself in the full light, and finally lies flat on the water, protected against the wet by a fine, bright coating of wax. It is wonderful how large masses of organized material a water plant can lay up with the help of these floating leaves. The great Victoria Regia grows to its full size in a single year from a small seed. Nearly its whole mass is prepared during growth in the leaves, which can perform such a work only in the strong light and the warmth of the tropical zone.

Submerged plants, as we have already said, are less well provided as to the reception of light than those with floating leaves. Hence those are chiefly small forms which we find at the bottom of our waters. Of these the *Algæ* are the most numerous. There are, indeed, on the whole earth no wet, only moderately light places where *Algæ* have not established a home. Insensible in a high degree alike to heat and cold, they are capable of growing on the snow of the Alps and on the edges of hot springs. We find them on the stones of rushing mountain torrents, in the plunge of the steepest waterfalls, and in the surf of the seacoast, and again at the bottom of the nearly motionless waters of ditches and ponds. The diversity of their habitats corresponds with the immense multitude of their forms. In the form of microscopic dots they will gradually change all the water of a pond or lake into a disagreeable turbid, green, often rank-smelling fluid; sometimes floating on its surface as green or yellow wads dotted with air bubbles; sometimes they appear at the bottom of the water as thick, roundish bundles of green, tangled threads; sometimes as slippery brown coatings.

The *Algæ* of the sea, or seaweeds, are strikingly rich in coloring. Besides green, there are in the sea black, brown, and red forms, the last, under favorable conditions of light, often attaining great size. They seem to be adapted by their peculiar coloring to the tempered blue light of the deeper strata of water. In the great deeps the plant life of the sea is extinguished for want of light. At a hundred metres beneath the surface only a few *Algæ* are found. These are plants of the shade, needing little light. Some of them continue to grow without interruption through the three months' polar night of Spitzbergen, and develop their invisible flowers and fruits at this season with the temperature of the water below the freezing point. The giants of the *Algæ* seek the enjoyment of uninterrupted sunlight. They grow in the deep waters near the shore, and send up slender stalks which pass at the surface of the water into long, shredded leaf forms. *Algæ* of this kind form, on the Chilian coast, for instance, forests in which specimens may be found more than two hundred metres long.

We return, after this excursion into the curious world of the *Algæ*, to the higher plants, and inquire whether there are not special adaptations to a life in the water in the conditions of their blossoming.

The flower of the phanerogam is adapted in general to life in the air and the light. We find, therefore, that the flowers of many water plants with floating leaves aim to reach the surface of the water. They require for the transfer of the pollen to the ovule the aid of the wind or of the insects which hover thickly over the water. Their emergence is effected with the help of floats of various kinds, of which it is sufficient to recall here a much-cited example. In the *Vallisneria*, the long, grasslike leaves of which form a kind of turf at the bottoms of some of the south European lakes, the inconspicuous male flowers rise in knobby bunches protected by a turgid envelope at the bottom of the water. The female flowers stand singly on very long, threadlike stems which rise to the top of the water. When the pollen has matured, the covering of the male flowers opens and the flowers escape in the form of little balls, which, being very light, rise at once to the surface of the water. Here are unfolded three white leaves, which, to use a figure of Kerner's, float around like pollen-laden canoes, and are so wafted by the wind as to convey their freight to the female flowers. While the fruit is forming, the stems of the female flowers roll up spirally and draw the seeds down into the protecting deeps, to remain there undisturbed till the time of germination. The flowers of many water plants, except for these processes, remain concealed in the deep throughout their lives. They do not there bring all their functions to fruiting, which can be accomplished only in the air. Without color or fragrance, they are inconspicuous; their structure is distinguishable only under close examination, and they are proved to be real flowers only by their pollen-shedding and their formation of seeds. Again arise in water plants special tasks. It is incumbent upon one to spread itself as widely as possible and establish its posterity in new places, where it may obtain room for free development and will not be dwarfed under the shadow of larger plants. The seeds, therefore, must not stay where they have fallen when ripened. They must be scattered, and by all means carried away from the immediate neighborhood of the mother plant. The fruits or seeds of water plants are therefore largely endowed with aids to swimming, by the help of which they can accomplish long distances. They share this provision with many shore plants, the whole existence of which is connected with the water in more than one respect. Among these is the cocoa palm, the gigantic fruits of which are comparatively very light. Filled within with cocoanut milk and cocoa butter, food for the young sprout, they pos-

sess a thick hull of loosely woven fibers, which forms a most excellent raft to carry the fruit far over the sea till it is stranded on some island to grow there into a new tree. Hence the cocoa palm is the first settler on all coral reefs that rise above the sea, and becomes the most characteristic element of tropical landscapes.

Other water plants employ animals as means of transport. They are swallowed by fishes, from the intestines of which they pass undigested.

The method of dispersion of many of the *Algæ* is especially interesting. They produce wandering cells which, endowed like the infusoria with free motion, shoot around in the water till they find a point on which they can settle themselves and grow. The lens will show us on a stone in the brook or on a dry limb that has fallen into the water a small group of slender threads, perhaps about a third of an inch high, each of which consists of a row of cylindrical cells set one upon another. If we take the plants home, wrapped with their support in round paper or moss, and put them in a dish of fresh water, we shall often be able in a short time to observe the spectacle of the formation of wandering cells. With a microscope we can see the individual cells breaking up and their contents creeping out of the cleft in the form of oval bodies. At the forward end of these swarms we may observe a number of fine threads which swing rapidly back and forth till they acquire a rotary motion, by means of which they swim spirally forward. The Austrian botanist Unger, who was among the first to observe the formation of wandering cells, believed at the time that he had surprised the plants in the act of becoming animals. The vegetable wanderers are, in fact, wonderfully like minute water animals. Many of them have red spots in front, which some have not irrationally supposed were light-perceiving organs or eyes of the simplest sort.

The question whether plants have a consciousness meets us here more impressively than anywhere else in the vegetable kingdom. As we observe how wandering cells swim toward foodstuffs and avoid poisons, seek moderate light and retire from strong light, and distinguish their own likes from the wandering cells of other plants, we find also really no difference. We have to concede that the same feelings and expressions are apparent in both; and if we ascribe a kind of soul to the animals, we can not deny it to the plants. We can not expect to find thought and reason in these circles of simplest light. Those are the prerogatives of the highest inhabitants of earth. The whole existence of these lower beings consists in the unconscious reception of impressions and the unconscious movements occasioned by it. The

vital career of the annual water plants closes with the formation of the seed. They die and fall into decay through the agency of the water bacteria, whose activity carries their substance on to renewed life in the circulation of matter. The vegetation of most of our northern perennial water plants is interrupted during the winter. Some of them, like the pond lily, have long rootstocks, in which superfluous food is deposited as in a storehouse in the course of the summer, to serve in the spring for the formation of the new leafy growth; others form special winter buds which, likewise filled with food, separate from the mother plant, sink to the ground, or are frozen in the ice, till the returning warmth of the sun revives them.

Having sought to uncover the mysteries of the household life of the water plants, we now turn to their relations to other families. No group of organisms has ever been able to develop itself independently of all other living beings. Individuals have to acquire the useful properties we admire in them in constant conflict—plants especially, in conflict with the animal world; and the vegetation of the water is as much subject to it as any other. Besides the fishes, there are the water snails and innumerable crustaceans, large and small, turning to water plants for food. Some plants are protected against these creatures by the presence of substances that give their leaves a bitter taste; some have many pointed prickle cells in the interior of their leafstalks which make it impossible for their enemies to bite through them. Most of the seaweeds are furnished with slimy cell walls, on which the water snails try their teeth in vain. The calcareous *Algæ* of the sea enjoy the best protection in the shape of a knotty or coralline form which has little resemblance to a plant, and through the deposition of carbonate of lime in their cell walls, almost turning them into real stone. Only a few marine animals know how to attack them. Among these is a snail that dissolves the lime by means of a secretion of sulphuric acid. With the same material, as Semon has shown, these snails also make sea urchins and starfish digestible, and are therefore brought in reach of an unusual variety of food, in which they are rivaled only by the lobster with his strong cutting jaws.

There are, besides, animal-catching plants among the water vegetation—as the common bladderwort (*Utricularia*), a yellow-flowering plant, with slender stem and finely dissected leaves, which is abundant in still waters in summer. Its leaves bear on and between their points round bladders, about as large as the head of a pin, which serve as animal traps. The most interesting part is an elastic lid, which opens only toward the interior. A wreath of glandular hairs surrounding the entrance of the bladder secretes a slimy material which entices the smaller

water crustacea to their destruction. They swim up greedily and collect at the mouth of the bladder to enjoy their feast. One of the guests ventures to get upon the lid. He remains there at first quietly held; but upon his making a more vigorous motion, the lid opens suddenly, swallows the little animal, and then closes again. The captive struggles awhile to escape from his prison, but gradually his movements become weaker, and he dies at last. Now the hairs clothing the interior walls of the bladder begin their work of imbibing food from the softer parts of the animal. When we reflect that a length of a finger and a half of a branch of the bladderwort can thus entrap two hundred of the little crustaceans, we can easily comprehend how the plant can do without roots, upon which it would otherwise depend for its supply of nitrogenous food.

In view of certain investigations which have been made of water flora and fauna for special purposes, I add a few words on the place of the water flora in the economy of Nature. The lower vegetation is of very great importance, especially the microscopic plants, innumerable plantations of which inhabit extensive tracts of all, and especially of northern, lakes. They move around in the water in masses or singly, changing the deep blue color of the spots destitute of organisms into green or dirty yellow. Most numerous among these minute plants wandering in lakes are the diatoms or siliceous *Algæ*, the richness of the forms of which surpasses all imagining. They consist of a nucleus of living substance inclosed as in a box between two siliceous shells. These shells bear markings so fine that they are used, in the same way as the dust of butterflies' wings, as tests for the delicacy of our best microscopes. The diatoms move through the water by the aid of a peculiar propulsory apparatus till they dying sink to the bottom and there go to help form the slime which is of so great importance in the evolutionary history of the crust of the earth. There are also diatoms in fresh water. They are the principal constituents of the brownish-yellow slippery coating of the stones in the beds of brooks.

The work of these and other similar living beings in the economy of Nature is not therefore lost, because they help with their dead remains to build up the dry land and prepare the ground for future generations. Their existence is thus of benefit to their fellow-creatures. As on the land, so there are plants in the sea which elaborate the unenlivened substances of the air and of the mineral kingdom and convert them into matter to become constituents of the bodies of living beings. Inasmuch as they serve as food, or as animals living upon them fall victims to the larger animals, they are the support of the whole animal life of the ocean. When we consider that twelve million individ-

uals of one species of these sea plants hardly contain a half gramme of organic substance, the endless mass of life that perishes to form the material for a whale, for instance, becomes inconceivable.—*Translated for The Popular Science Monthly from the Deutsche Rundschau.*

STUDIES OF CHILDHOOD.

XI.—MATERIAL OF MORALITY.

By JAMES SULLY, M. A., LL. D.,
GROTE PROFESSOR OF THE PHILOSOPHY OF MIND AND LOGIC AT THE UNIVERSITY COLLEGE, LONDON.

(*b*) UNTRUTH AND TRUTH.

WE may now turn to the other main charge against children, that of lying. According to many, children are in general accomplished little liars, to the manner born, and equally adept with the mendacious savage. Even writers on childhood by no means prejudiced against them lean to the view that untruth is universal among children and to some extent at least innate.*

Here, surely, there is need of discrimination. A lie connotes, or should connote, an assertion made with full consciousness of its untruth and in order to mislead. It may well be doubted whether little children have so clear an apprehension of what we understand by truth and falsity as to be liars in this full sense. Much of what seems shocking to the adult unable to place himself at the level of childish intelligence and feeling will probably prove to be something far less serious. It is satisfactory to note a tendency to take a milder and more reasonable view of this infantile fibbing; and what follows is based upon the excellent recent studies of Dr. Stanley Hall and M. Compayré.†

It is desirable to inspect a little more closely the various forms of this early mendacity. To begin with those little ruses and dissimulations which according to M. Perez are apt to appear almost from the cradle in the case of certain children, it is plainly difficult to bring them under the category of full-fledged lies. When, for example, a child wishing to keep a thing hides it, and on your asking for it holds out its empty hands, it would be hard to say that this was a lie, even though there is a germ of deception in the action. We must remember that children have an early developed instinct to secrete things, and the little dissimulations in these

* See the quotations from Montaigne and Perez given by Compayré, *op. cit.*, p. 309 ff.

† Stanley Hall, Children's Lies, American Journal of Psychology, 1890. Compayré, *op. cit.*, p. 309 ff.

actions may be a mere outcome of this hiding propensity, and the accompanying wish that you should not get the hidden thing. Refusals to tell secrets, or, as C—— called them, "private secrets" (a fine distinction), show the same thing. A child, when badgered, is most jealous in guarding what he has been told, or what his fancy has made a secret. The little ruses or "acted lies" to which I am now referring seem to me at the worst an attempt to put off the scent in what is regarded as a private matter, and to have the minimum of intentional deception.

More distinct marks of mendacity appear when the child comes to use language and offers statements which if he reflected he might know to be false. It may readily be thought that no child who has the intelligence to make statements at all could make false ones without some little consciousness of the falsity. But here I suspect we judge harshly, applying adult tests to cases where they are inappropriate. Anybody who has observed children's play and dramatic talk and knows how readily and completely they can imagine the nonexistent so as to lose sight of the existent, will be chary of using the word lie. There may be solemn sticklers for truth who would be shocked to hear the child in play saying, "I am a coachman," "Dolly is crying," and so forth. But the discerning see nothing to be alarmed at here. Similarly, when a little girl of two years and six months, after running over a pretty long series of sounds devoid of all meaning, said, "It's because you don't understand me, papa." Here the love of mystery and secrecy, aided by the dramatic impulse, *made* the nonsense real talk. The wee thing doubtless had a feeling of superiority in talking in a language which was unintelligible to her all-wise papa.

On much the same level of moral obliquity are those cases where a child will say the opposite of what it is told, turning authoritative utterances upside down. A quaint instance is quoted by Compayré from Guyau. Guyau's little boy (age not given) was overheard saying to himself, "*Papa parle mal, il a dit sevette; bébé parle bien, il dit serviette.*" Such reversals are a kind of play too; the child is weary of being told he is wrong, and for the moment imagines himself right and his elders wrong, immensely enjoying the idea.

A graver-looking case presents itself when an "untruth" is uttered in answer to a question. C——, on being asked by his mother who told him something, answered "Dolly." False, and knowingly false, somebody will say, especially when he learns that the depraved youngster instantly proceeded to laugh. But let us look a little closer. The question had raised in C——'s little mind the idea that somebody had told him. This is a process of suggestion, which as we shall see presently, sways a child's

mind as it sways that of the hypnotized adult. And there close by the child was Dolly, and the child's make-believe includes, as we all know, much important communication with Dolly. What more natural than that the idea should at once seize his imagination? But the laugh? Well, I am ready to admit that there was a touch of playful defiance here, of childish mischief. The expression on the mother's face showed him that his bold, absurd fancy had produced its half-startling, half-amusing effect; and there is nothing your little actor likes more than this after effect of startling you. But more, it gave him at the same instant a glimpse of the outside look of his fancy, of the unreality of the untruth; and the laugh probably had in it the delight of the little rebel, of the naughty, impish rogue who loves now and then to set law at defiance.

Momentary vivid fancy, the childish passion for acting a part, this backed by a strong desire to startle, and a turn for playful rebellion, seems to me to account for this and other similar varieties of early misstatement. Naughty they no doubt are in a measure; but is it not just that playing at being naughty which has in it nothing really bad, and is removed *toto cælo* from downright honest lying? I speak the more confidently as to C——'s case, as I happen to know that he was in his serious moods particularly, one might add pedantically, truthful.

A somewhat different case is where the vivid fancy underlying the misstatement leads to a more serious self-deception. The Worcester collection gives an example: "I was giving some cough sirup, and E——, aged three years and two months, ran to me, saying, 'I am sick too, and I want some medicine.' She then tried to cough. Every time she would see me taking the sirup bottle afterward, she would begin to cough. The sirup was very sweet." This looks simply awful. But what if the child were of so imaginative a turn that the sight of the sirup given to the sick child produced a perfect illusion of being herself sick—an illusion strong enough to cause the irritation and the cough? The idea may seem far-fetched, but deserves to be considered before we brand the child with the name liar.

The vivid, fanciful realization, which in this instance was sustained by the love of sweet things, is in many cases inspired by other and later developed feelings. How much false statement—and that not only among little children—is of the nature of exaggeration and directed to producing a strong effect! When, for example, the little four-year-old draws himself up and shouts exultantly, "See, mamma, how tall I am—I am growing so fast I shall soon be a giant," or boasts of his strength, and tells you the impossible things he is going to do, the element of braggadocio is on the surface and imposes on nobody.

No doubt these propensities, though not amounting in the stage of development now dealt with to full lying, may, if not restrained, develop into true lying. An unbridled fancy and strong love of effect will lead an older child to say what it vaguely knows at the time to be false in order to startle and mystify others. Such exaggeration of these impulses is distinctly abnormal, as may be seen by its affinity to what we can observe in the case of the insane. The same is true of the exaggeration of the vainglorious or "showing-off" impulses, as illustrated, for example, in the cases mentioned by Dr. Stanley Hall of children who, on going to a new town or school, would assume new characters which were kept up with difficulty by means of many false pretenses.*

A fertile source of childish untruth, especially in the case of girls, is the wish to please. Here we have to do with very dissimilar things. An emotional child who, in a sudden fit of tenderness for mother, aunt, or teacher, gushes out, "Oh, I *do* love you!" or "What sweet, lovely eyes you have!" or other pretty flattery, may be sincere for the moment, the exaggeration being indeed the outcome of a sudden ebullition of feeling. There is more of acting and artfulness in the flatteries which take their rise in a calculating wish to say the nice, agreeable things. Some children are, I believe, adepts at these amenities. Those in whom the impulse is strong and dominant are presumably those who, in later years, make the good society actors. In all this childish simulation and exaggeration we have to do with the germs of what may become a great moral evil—insincerity—that is, falsity in respect of what is best and ought to be sacred. Yet this childish flattery, though undoubtedly a mild mendacity, is a most amiable mendacity through its charming motives, always supposing that it is a pure wish to please and is not complicated with an *arrière pensée*—the hope of gaining some favor from the object of the devotion. Perhaps there is no variety of childish fault more difficult to deal with, if only for the reason that in checking the impulse we are robbing ourselves of the sweetest offerings of childhood.

The other side of this wish to please is the fear to give offense, and this, I suspect, is a fertile source of childish prevarication. If, for example, a child is asked whether he does not like or admire something, his feeling that the questioner expects him to say "Yes" makes it very hard to say "No." Mrs. Burnett gives us a reminiscence of this early experience. When she was less than three, she writes, a lady visitor, a friend of her mother, having found out that the baby newly added to the family was called

* Article Children's Lies, p. 67.

Edith, remarked to her: "That's a pretty name. My baby is Eleanor. Isn't that a pretty name?" On being thus questioned she felt in a dreadful difficulty, for she did not like the sound of "Eleanor," and yet feared to be rude and say so. She got out of it by saying she did not like the name as well as "Edith."

These temptations and struggles, which may impress themselves on memory for the whole of life, illustrate the influence of older persons' wishes and expectations on children's statements. It is possible that we have here to do with something akin to "suggestion," that force which produces such amazing results on the hypnotized subject, and which is known to be a potent influence for good or for evil on the young mind. A leading question of the form: "Isn't this pretty?" "Aren't you fond of me?" may easily overpower for a moment the child's own conviction, superimposing that of the stronger mind. Such passive statements coming from a mind overridden by another's authority are not to be confused with conscious falsehoods.

This suggestion often combines with other forces. Here is a good example: A little American girl, sent into the oak shrubbery to get a leaf, saw a snake, which so frightened her that she ran home without the leaf. As cruel Fate would have it, she met her brothers and told them she had seen a "sauger." "They knew" (writes the lady who recalls this reminiscence of her childhood) "a difference between snakes and their habits, and, boylike, wanted to tease me, and said, 'Twas no sauger—it didn't have a red ring round its neck, now, did it?' My heated imagination saw just such a serpent as soon as their words were spoken, and I declared it had a ring about its neck." In this way she was led on to say that it had scars and a little bell on its neck, and was soundly rated by her brothers as a "liar."* Here we have a case of "illusion of memory" induced by suggestion acting on a mind made preternaturally sensitive by the fear from which it had not yet recovered. If there was a germ of mendacity in the case, it must have sprung from the half-conscious shrinking from the brothers' ridicule, the wish not to seem utterly ignorant about these boyish matters, the snakes. Yet who would say that such swift, unseizable movements of feeling in the dim background of consciousness made the child's quick responses lies in the proper sense of the word?

It seems paradoxical, yet is, I believe, indisputable, that a large part of childish untruth comes upon the scene in connection with moral authority and discipline. We shall see by and by that unregenerate child-nature is very apt to take up the hostile attitude of self-defense toward those who administer law and inflict

* Sara E. Wiltse, The Christian Union, vol. xl, No. 26.

punishment, Even the mother herself, beloved as she undoubtedly is, comes in for this antagonism. When the moral *régime* is severe and something like dread of punishment arises, the problem of self-protection is wont to be solved by well-known devices in the shape of subterfuges. In this way a child will say, "I didn't hear you," when a command is given and not at once obeyed; "*I* didn't make the mess, it was *my hand*," and so forth. Quite young children will find their way to little ruses and deceits of this sort when brought face to face with a sharp-faced threatening authority. Thus a mite of three, having in a moment of temper called her mother "monkey," and being questioned as to what she had said, replied, "I said I was a monkey." In some cases the child does not wait to be questioned. A little girl mentioned by Compayré, being put out at something the mother had done or said, cried "Nasty!" (*vilaine*); then, after a significant silence, corrected herself in this wise: "Dolly nasty" (*poupée vilaine*). The skill with which this transference was effected without any violence to grammar argues a precocious art.

I do not wish to say that these prevarications, these dodges for getting out of obedience, or, if disobedience has been detected, of evading punishment, are not rightly named untruths. With every wish to excuse children's peccadillos one can not but recognize here a rudiment of the wish and intention to deceive.

Yet surely it is a matter deserving of reflection that our modes of governing (or misgoverning) children so frequently develop these tricky prevarications. It is not too much to say that anything in the nature of a brutal and terrifying government drives children to these subterfuges as their only resource. I at least should never blame a child greatly for trying to save himself by an untruth with the terror of the "giant" armed with stick or cane hanging over him.

Our moral discipline may develop untruth in another way. When the punishment has been inflicted and the governor, relenting from the brutal harshness, asks, "Are you sorry?" or "Aren't you sorry?" the answer is exceedingly likely to be "No," even though this is in a sense untrue. More clearly is this lying of obstinacy seen where a child is shut up and kept without food. Asked, "Are you hungry?" the hardy little sinner stifles his sensations and pluckily answers "No," even though the low and dismal character of the sound shows that the untruth is but a half-hearted affair.

There is much even yet to be done in clearing up the *modus operandi* of children's lies. How quick, for example, is a child to find out the simple good-natured people, as the servant-maid or gardener, who will listen to his romancing and flatter him by appearing to accept it all as gospel! More significant is the fact

that intentional deception is apt to show itself toward certain people only. There is many a schoolboy who would think it no dishonor to say what is untrue to those he dislikes, especially by way of getting them into hot water, though he would feel it mean and base to lie to his mother or his father, and bad form to lie to the head master. Similar distinctions show themselves in earlier stages, and are another point of similarity between the child and the savage, whose ideas of truthfulness seem to be truthfulness for *my* people only. This is a side of the subject which would repay fuller inquiry.

Another aspect of the subject which has been but little investigated is the influence of habit in the domain of lying and the formation of persistent permanent lies. The impulse to stick to an untruth when once uttered is very human, and in the case of the child is enforced by the fear of discovery. This applies not only to falsehoods foisted on persons in authority, but to those by which clever boys and girls take pleasure in befooling the inferior wits of others. In this way there grow up in the nursery and in the playground traditional myths and legends which are solemnly believed by the simple-minded. Such invention is in part the outcome of the "pleasures of the imagination." Yet it is probable that this is in all cases re-enforced not only by the wish to produce a showy effect, but by the love of power which in the child not endowed with physical prowess is apt to show itself in hoodwinking and practical joking.

Closely connected with this establishment of permanent falsehoods is the contagiousness of lying. The propagation of falsehood is apt to be promoted by a certain tremulous admiration for the hardihood of the lie and by the impulse of the rebel which never quite slumbers even in the case of fairly obedient children. I suspect, however, that it is in all cases largely due to the force of suggestion. The falsehood boldly anounced is apt to captivate the mind and hold it under a kind of spell.

This effect of suggestion in generating falsehood is very marked in those pathological or semi-pathological cases where children have been led to give false testimony. It is now known that it is quite possible to provoke in children between the ages of six and fifteen by simple affirmation, whether in the waking or in the sleeping state, illusions of memory, so that they are ready to assert that they saw things happen which they had never seen.*

---

* M. Motet was one of the first to call attention to the forces of childish imagination, and the effects of suggestion in the false testimonies of children. Les faux temoignages des enfants devant la justice, 1887. The subject has been further elucidated by Dr. Bérillon.

So much as to the several manners and circumstances of childish lying. In order to understand still better what it amounts to, how much of conscious falsehood enters into it, we must glance at another and closely related phenomenon—the pain which sometimes attends and follows it.

There is no doubt that a certain number of children experience qualms of conscience in uttering falsehood. This is evidenced in the well-known devices by which the intelligence of the child thinks to mitigate the lie, as when on saying what he knows to be false he adds mentally, "I do not mean it," "in my mind," or some similar palliative.* Such dodges show a measure of sensibility—a hardened liar would despise the shifts—and are curious as illustrations of the childish conscience and its unlearned casuistry.

The remorse that sometimes follows lying, especially the first lie which catches the conscience at its tenderest, has been remembered by many in later life. Here is a case: A lady friend remembers that when a child of four she had to wear a shade over her eyes. One day, on walking out with her mother, she was looking, child-wise, sideward instead of in front, and nearly struck a lamp-post. Her mother then scolded her, but presently, remembering the eyes, said, "Poor child, you could not see well." She knew that this was not the reason, but she accepted it, and for long afterward was tormented with a sense of having told a lie. Miss Wiltse, who tells the story of the mythical snake, gives another recollection which illustrates the keen suffering of a child when it becomes fully conscious of falsehood. She was as a small child very fond of babies, and had been permitted by her mother to go, when invited by her aunt, to nurse a baby cousin. One day, wanting much to go when not invited, she boldly invented, saying that her aunt was busy and had asked her to spend an hour with the baby. "I went," she adds, "not to the baby, but by a circuitous route to my father's barn, crept behind one of the great doors, which I drew as close to me as I could, vainly wishing that the barn and the haystacks would cover me; then I cried and moaned I do not know how many hours, and when I went to bed I said my prayers between sobs, refusing to tell my mother why I wept."†

Such examples of remorse are evidence of a child's capability of knowingly stating what is false. This is strikingly shown in Miss Wiltse's two reminiscences, for she distinctly tells us that in the case of her confident assertion about the imaginary snake with ring and bell she felt no remorse, as she was not conscious of uttering a lie. But these sufferings of conscience point

* See Stanley Hall, *op. cit.*, p. 68 f. † *Loc. cit.*

to something else—a sense of awful wickedness, of having done violence to all that is right and holy. How, it may be asked, does it happen that children feel thus morally crushed after telling a lie?

Here is a question that can only be answered when we have more material. We know that lying is, among all childish offenses, the one which is apt to be specially branded by theological sanctions. The physical torments with which the "lying tongue" is threatened may well beget terror in a timid child's heart. I think it likely, too, that the awfulness of lying is thought of by children in its relation to the all-seeing God, who, though he can not be lied to, knows when we lie. Possibly the inaudible palliative words added to the lie are specially intended to put the speaker straight with the heart-searching God.

Further inquiry is, however, needed here. Do children contract a horror of a lie when no religious terrors are introduced? Is there anything in the workings of a child's own mind which would lead it to feel, after its first lie, as if the stable world were tumbling about its ears? Let parents supply us with facts here.

Meanwhile I will venture to put forth a conjecture, and will gladly withdraw it as soon as it is disproved.

So far as my inquiries have gone, I do not find that children brought up at home and kept from the contagion of bad example do uniformly develop a lying propensity. Several mothers assure me that their children have never seriously propounded an untruth. I can say the same about two children who have been especially observed for the purpose.*

This being so, I distinctly challenge the assertion that lying is instinctive in the sense that a child, even when brought up among habitual truth-tellers, shows an unlearned aptitude to say what it knows to be false.

I go further and suggest that where a child is brought up normally—that is, in a habitually truth-speaking community—he tends quite apart from moral instruction to acquire a respect for truth as what is customary. Consider for a moment how busily a child's mind is occupied during the first years of linguistic performance in getting at the bottom of words, of fitting ideas to words when trying to understand others, and words to ideas when trying to express his own thoughts, and you will see that all this must serve to make truth—that is, the correspondence of statement with facts—something matter-of-course, something not to be questioned, a law wrought into the very usages of daily life

* Dr. Stanley Hall, when he speaks of certain forms of lying as prevalent among children, is, as he expressly explains, speaking of children *at school*, where the forces of contagion are in full swing.

which he never thinks of disobeying. We can see that children accustomed to truth-speaking show all the signs of a moral shock when they are confronted with assertions which, as they see, do not answer to fact. The child C—— was highly indignant on hearing from his mother that people said what he considered false things about horses and other matters of interest; and he was even more indignant at meeting with any such falsity in one of his books, for which he had all a child's respect. The idea of perpetrating a knowing untruth, so far as I can judge, is simply awful to a child who has been thoroughly habituated to the practice of truthful statement. May it, then, not well be that when a preternatural pressure of circumstances pushes the child over the boundary line of truth, he feels shock, horror, a giddy and aching sense of having violated law—law not imposed by the mother's command, but rooted in the very habits of social life? I think the conjecture is well worth considering.

Our inquiry has led us to recognize, in the case of cruelty and of lying alike, that children are by no means morally perfect; they have tendencies which, if not counteracted or held in check by others, will develop into true cruelty and true lying. On the other hand, our study has shown us that these impulses are not the only ones. A child has impulses of kindness, which alternate, often in a capricious-looking way, with those of inconsiderate teasing and tormenting; and he has, I hold, side by side with the imaginative and other tendencies which make for untruthful statement, the instinctive roots of a respect for truth. These tendencies have not the same relative strength and frequency of utterance in the case of all children, some showing, for example, more of the impulse which makes for truth, others more of the impulse which makes for untruth. Yet in all children probably both kinds of impulse are to be observed. All which means that the child is at first a congeries of uncoördinated propensities, some favorable, others unfavorable, to what we mean by goodness, and that education has to transform this into a moral organism in which the tendencies to the good shall become supreme and act controllingly on the tendencies to the bad.

THE English Chemical Society has conferred its Faraday medal on Lord Rayleigh in recognition of the investigation that has led to the discovery of argon. Chemists have before this made excursions into the domain of physics; but Lord Rayleigh, a physicist and mathematician, has turned the tables upon them by making a discovery of first-rate importance in the domain of chemical inquiry. His work is the more remarkable because it was carried on on purely physical lines. It is curious to reflect that only lack of needful delicacy in measurement delayed for one hundred and ten years the discovery on the threshold of which Cavendish stood in 1785.

HUNTING WITH BIRDS OF PREY.

By M. EDOUARD BLANC.

AMONG the animals that man has in different periods of history forced to serve his purposes, none are now so much neglected in western lands as birds of prey. These creatures, however, at a time which is not yet far away from us, constituted the essential factor of falconry, which was a few centuries ago held in the highest honor. This sport, although it has fallen into decay in Europe, is still practiced in northern Africa and some parts of Asia, chiefly central Asia. Having had occasion to indulge in it much on my own account in both these regions, I am able to speak from personal experience of the manner in which it is practiced there. Falconry in Africa, where it has come down from the Arabs of the middle ages, has been described many times, especially from the picturesque point of view. I shall speak especially of the sport in central Asia, where, while it is less known to Westerners, it is practiced more perfectly than in any other country. It has entered completely into the habits of the people, and it is not there, as in Africa, limited to a small number of wealthy proprietors.

The exhibition at Tashkend in 1891 included a department of the chase, in which the most distinguished falcon teams of Turkistan figured prominently. The Khan of Khiva was an exhibitor, and was represented by his best birds and his most skillful falconers. Instead of allotting the prizes, according to the most usual plan, to the best-looking birds, matches were instituted and the relative merit of the competing birds was determined by the test of what they could do. I had an opportunity on this occasion to make a thorough study of the technical details of a sport which I had already practiced under different circumstances.

Such large birds as the eagle are trained for falconry in Turkistan, and are used for the capture of foxes, gazelles, antelopes, and even, it is said, deer. They are so heavy that the falconer is not able to carry them on his arm alone, and has to support it on a wooden prop, the base of which is attached to his saddle.

According to the Arabian traditions, the training of the falcon to hunt was first accomplished by an inhabitant of Mosul; but the training of the eagle has been practiced by the Chinese and the Mongols from an antiquity much more remote than the Arabian period, and falconry was probably introduced into Turkistan from the north of China, and then into Persia, perhaps by some Hunnish people.

Falconry is so deeply established in Turcoman life that people in modest conditions and even children engage in it. A favorite

winter game of the children in the streets of Samarcand and other large cities of central Asia consists in setting in flight crows which are held by long strings tied to the hand, and practicing the exercises of falconry with them.

Female birds are preferred in both Asia and Africa, as being larger and stronger than males, and are more readily trained; but males are also sometimes used. Among the great variety of birds of prey in Turkistan, those which are habitually domesticated are first the falcons and hawks. The common goshawk

FIG. 1.—GOLDEN EAGLE (*Aquila chrysaëtos*).

(*Astur palumbarius*) and the sparrow hawks (*Accipiter nisus* and *Accipiter virgatus*) are most usually employed and most valued. They are used principally for taking pheasants, partridges, and quails. Most of the buzzards are trained. The kites, which were supposed in ancient European falconry not to be susceptible of training, are used with success. The *Milvus melanotis*, which has been identified by Pallas with the black kite of Europe, but is probably distinct, proves to be quite tractable.

The golden eagle (*Aquila chrysaëtos*), *Aquila daphnea*, and *Aquila clanga* are habitually trained, and are mentioned by trav-

elers, and other varieties or species of eagle are employed. Owls are sometimes trained, but are good only for hunting at night.

Every Turcoman has at least one of these trained birds, of breed and size corresponding with his fortune. They may be seen sitting on their perches in the rear of the bazaars and in the meanest shops, where they are made as much of as any other domestic animal. Whenever their owner goes out for any long distance over the plains, he takes his bird on his wrist or on the horn of his saddle, and if any game crosses his track launches the falcon out against it, as surely as a European or American would shoot at it. The falcon, let loose, flies till it is directly over the game, and then pounces down upon it in a dizzy fall which requires to be directed with the most exact precision, for, with his wings folded, he descends in the perpendicular line, by the sheer force of his weight, and may strike the game or not. If he fails, the hunter draws him in and holds him ready to be sprung at the next victim.

Birds intended to be used in falconry are taken from the nests when very young and trained from the beginning. They are easily found, for, there being no trees in the steppes, they are obliged to nest on the ground or in bushes. Adult birds can also be captured and made useful, and this is done among the Arabs as it formerly was in Europe. One of the methods of catching them is ingenious and curious. Pebbles as large as the bird can swallow without great inconvenience are dipped in blood, which is allowed to curdle on their surface, and are put in places which the hawks frequent. The birds swallow them greedily till they are so weighted down that they can not fly away. The hunters then come up and take them by hand.

As the purpose of central Asian falconry is different from that which was sought in European falconry in the middle ages, different qualities are prized in the birds. Originally, indeed, the purpose was the same in both regions—namely, to capture game which could not be reached with the imperfect arms in use. But falconry became a fine art in Europe, and the skill acquired in cultivating it caused it to be kept in practice long after firearms became common. It was practiced as a matter of pastime and a method of showing off accomplishments; and there was an æsthetic pleasure in watching the lofty flight of the birds and the precision and swiftness with which they would light upon their prey. Those birds were valued highest which, when they missed their mark, would spread their wings before they reached the ground, and soar up again, trying to recover by the speed of their flight the advance which the game made in the interval, and then dash down again and again until they succeeded or the game got out of their reach. On the other hand, those birds which flew

directly from the falconer's hand to the game and seized it were regarded as ignoble and of base flight. The Turcomans, Chinese, and Kirghiz, being more practical in their views, especially esteem these birds of direct flight, and have carried their training to a high degree of perfection. The Turcoman nomad, hunting his game as a matter of business, does not want his falcon to attack it too savagely; that would be a waste. His bird should strike the animal as a bullet or an arrow would, and, if he misses it, should stay upon the ground within reach of his master. In the oases like those of Samarcand and Tashkend, wooded with large trees and intercepted by high walls and wide and deep canals, a bird making long and circuitous flights would be often out of sight and sometimes hard to find. Hence birds that fly low are preferred to those that soar aloft.

FIG. 2.—GOSHAWK (*Astur palumbarius*).

Under these conditions the manner of dispatching the bird is of considerable importance. It is not usual to dispatch it for the game when it is still, but it is unhooded when the game is first seen and while it is yet in motion, and it should be started in such a way that the game shall be the first thing to attract its attention.

The only special articles in the costume of the falconers are the glove and the bird's hood. The glove is of white goatskin, and is armed with a gauntlet for the lower arm. The hood is a little sack of leather or padded cloth, furnished with a running string at its lower part and a leather or metallic ring on the upper part. To put the cap on, the bird is offered a piece of meat, while the owner holds the hood in such a position that it can be slipped over the bird's head as it stretches it out for the morsel. The meat is not given to the falcon, because if it were he would

not be so eager to pursue the game. It might be supposed that the falcon would not be drawn to its master by such deceit, but he comes to know his proprietor very well. Decoys are used in training the birds—a piece of stuffed rawhide so fixed as to resemble a hare or other animal sitting on the ground, or some feathered object which when thrown into the air falls with motions like those of a wounded bird. Falconers further provide themselves with a tambourine to call the bird back, a wooden prop fixed to the saddle and forked at the other end to sustain the arm on which the bird is carried, and perches and cages for use at home.

As a rule, the smaller these birds of prey are, the more ardent and brave they seem to be. Very small sparrow hawks and hobbies will attack ducks six times as large as themselves, while most of the larger falcons are only moderately eager for the hunt. Eagles, notwithstanding their size and strength, have very little interest in the sport, and have to be very hungry before they will attack game, and then the game must not be very far away, else they will simply look at it with a philosophic air calculated to make the hunter frantic.

Fig. 3.—Sparrow Hawk (*Accipiter nisus*).

The falcons of Africa are competent to capture chiefly hairy game, while of feathered game they are effective only against small birds and young bustards running along the ground. A good Asiatic falcon, on the other hand, is efficient against every kind of game bird except pigeons. Quails are almost a sure prey to them, and they can catch three fourths of the partridges and half the ducks which they attempt. Ducks, if they are missed at the first descent, often succeed in escaping, either by their cunning or by their power of flight. Pigeons are never taken unless they are surprised or have been wounded. In general, the Asiatic falcons have greater powers of flight than their African congeners; but the African birds are more trusty than the Asiatic. They are in the habit of hunting together, of assisting and re-enforcing one another, and will often answer when their name is called. In chasing a hare, for instance,

these birds will fly in a circle, on the lookout for game, in the direction toward which they are dispatched by command, or by the course of the horsemen. When one of them perceives a hare, he aims for it, in order to fall headlong upon it, trying to strike it with his claws or with his beak. If the animal does not remain still and the dash is therefore a failure, the bird reascends and tries his manœuvre over again, calling at the same time to his comrades. They respond, and dash in turn at the game till it is dispatched. If it escapes after it has been missed and succeeds in hiding itself, the birds describe circles as dogs do on similar hunts, and the one which finds it first calls to the others.

The Turkistan birds hunt each on his own account, and are indifferent about seeking game that they have missed. In a few instances, where wealthy proprietors have large packs, the birds have been taught to hunt together and to rally to one another; but such cases are exceptional.—*Translated for The Popular Science Monthly from the Revue Scientifique.*

WAR AS A FACTOR IN CIVILIZATION.

By CHARLES MORRIS.

MAN'S progress toward civilization has been by no royal road. His every step has been met by opposing influences, some of them inherent in Nature, others in the conditions of the social organism, whose action is to prevent any rapid or continuous development. He has, on the other hand, been helped by numerous agencies, some of them such as seem by no means adapted to become aids to civilization. Of these, unlikely as it may appear, the most important and effective has probably been that of war, an agent usually looked upon as simply destructive, but which is, as I hope to show, largely constructive in its effects.

It may seem to many readers absurd to speak of war as a helpful agency in civilization. It is the general impression that a state of profound peace, with its consequent agricultural and mechanical industries, is most conducive to human advancement. Warfare is usually looked upon as simply destructive, and as destitute of any redeeming feature; and yet I venture to claim that all the civilizations to-day existing were in their origin largely the results of ancient wars; and that peace, in the long past of the human race, was almost a synonym for social and intellectual stagnation. The views usually entertained as to the comparative advantages of peace and war apply only to our own enlightened age, and are not wholly correct even now. As applied

to the past ages of barbarism and semi-civilization they are far from being correct. Nor will it be difficult, in support of the above assertion, to present instances of long-prevailing peace and of continued warfare, and to show that the latter has had far the most beneficial influence on human progress.

I shall adduce some such instances here as historical evidences in support of my proposition, and afterward consider the causes which lead to such seemingly improbable results. While it may not be possible to name any nations which have existed for a long period in a state of profound peace, there are two very prominent ones which during many centuries have not indulged, or only to an unimportant extent, in foreign warfare. These two possessors of the golden age of peace are China and India. They have had their petty internal combats, but they have not gone abroad as conquerors. They have been conquered, at long intervals apart, by exterior races; but the influx of strange peoples has been like that of the waters of a brook into a lake—the vast masses of the conquered have given color to, instead of receiving color from, their few conquerors. Thus, in these two great nations, the results of long-continued peace have been attained to a more complete extent than elsewhere in the world of civilization.

But when we look at these results we are not strongly encouraged in favor of a golden age of peace. These nations have grown old as many men grow old, their prejudices become rigid, their conceits hardened, their beliefs inflexible. They have reached the limit of their narrow line of development, and crystallized there. Their ideas of industry, of social custom, of law and government, have become fixed and unchangeable. National isolation has removed China from the useful influence of intellectual contact with exterior peoples. Mental isolation has had the same effect in India. Local pride and self-satisfaction have hindered progress, but they have not hindered the deterioration which is sure to set in when progress halts. These nations having, ages ago, lost all active development, and solidified into unchangeable forms, they have become subject to the influences which affect a tree that has ceased to grow. Inevitable decay has supervened. Whole swarms of political, social, and moral delinquencies have crept in and fastened themselves upon the body corporate, which has lacked the vitality to throw them off, and which is being gradually consumed by these eating parasites.

It may be argued, however, that both these nations had attained a considerable degree of civilization before their progress became thus checked. This must be admitted; but it must also be admitted that this progress was chiefly attained during their earlier, warlike stage. Of this we have abundant evidence.

The intellectual growth of the Hindu people was certainly most pronounced in that early period when they were marching southward through hostile realms, and afterward fiercely fighting with the Indian aborigines for a home. It seems to have culminated shortly after this period, and before they sank into their subsequent state of profound peace. Since then they have produced literature, but have not advanced in civilization. In China, also, there is historical evidence of an ancient state of affairs widely different from that now existing. The earlier annals of the Chinese nation present us with a series of separate, independent provinces, among which China proper occupied but a contracted section in the northwest of the present empire. Gradually, through continued aggression, this province extended its borders, brought the others under a sort of feudal allegiance, and finally into complete subjection. During this period civilization was progressing. But since the final establishment of the empire within its present boundaries, and its inauguration of the policy of peace, progress seems to have halted, and mental stagnation to have replaced the ancient intellectual vitality.

If we now come to consider instances of warlike nations, it will be found that a complete parallel can not be made. Warlike nations do not subsist through uncounted generations like those at peace. They conquer and they are conquered; they destroy and they are destroyed; they die and leave their heirs. To consider them properly we must follow them through the long line of their descent, and see how the successive offspring have wrought with the talents of their far-off ancestry. This can not be easily done. Each heir has inherited from several warlike predecessors. There are no entailed estates of human progress, no fixed hereditary successions. The world has gathered up the scattered possessions of its broken peoples and built new empires upon their ruins.

Various examples of marked progress in warlike nations might be adduced from ancient history, particularly in the cases of Greece and Rome. In more modern times we have examples in the history of the Arabians after their proselyting outburst, of Spain after the expulsion of the Saracens, of Europe during the Crusades, and in the infiltration of liberal ideas into the European mind during the Napoleonic wars. But for a more complete illustration, equaling in length the period of the Chinese Empire, the history of western Europe during its whole civilized period must be taken, since, as the former presents us with an instance of almost unbroken peace, the latter yields an example of almost unceasing war. For several thousand years this region has been a theater of conflict: first, between Rome and its barbarian neighbors; second, between the Europeans and their Asiatic invaders;

third, between the several tribes and nations that succeeded Rome. There has been no rest in Europe, no isolation. War has gone on almost unceasingly, between lord and lord, tribe and tribe, nation and nation; and civilization has kept pace with it, developing with a rapidity in marked contrast with the stagnation of China during the same period.

The difference is a striking one. That war was its cause, it is true, may be open to question. Race distinctions may have had much to do with it; but these are certainly insufficient to explain the greatness of the difference, particularly when we remember that during the warlike and advancing period of China the Aryans of Europe were, so far as we are aware, in a state of tribal isolation and stagnation, with no hostilities other than intertribal quarrels. How long they had remained in this condition no one can tell. They broke out of it only when their period of migration and of warlike relations with foreign peoples began, and from that time forward they have steadily advanced from barbarism to high civilization.

If we ask what is the philosophy of this, the answer may not be difficult to reach. Unlike the fixed conservatism of peace, war introduces new conditions, new foundations for human thought, on which the edifice of future civilization may be erected; and, breaking up the isolation of peace, it spreads these conditions throughout the world, making distant nations participants in their influences. The progress of mankind means simply the development of the human mind. Ideas are the seeds of civilization, and under whatever form it appears the idea must be born first, the embodiment must come afterward. In seeking for the causes of advancement, then, we must seek for the sources of new ideas; but, as experience lies at the root of ideas, new ideas can only arise from new experiences. Whence, then, do we derive our experiences? No isolated individual can learn much of himself. His own powers of observation and thought are limited. Our minds can only rapidly develop when we avail ourselves of the experience of others. In this way only can they become storehouses of new thoughts. There is a common stock of such thought abroad in the world, from which we derive the great mass of the ideas which we call our own. And, obviously, that mind will be most developed which comes into contact with and assimilates the greatest number of these thoughts.

The same holds good with nations. An isolated nation is in the same position as an isolated individual. Its experiences are limited, its ideas few and narrow in range. Its thoughts move in one fixed channel, and the other powers of its mind are apt to become virtually aborted. An isolated nation, then, is not likely rapidly to gain new ideas. Yet peace, in all barbarian and semi-

civilized nations, seems to tend strongly toward this condition of isolation; and such isolation in its conservative influence is a fatal bar to any wide or continuous progress. The long persistence of one form of government, of one condition of social customs, of one line of thought, tends to produce that uniformity of character which is so fatally opposed to any width of development or breadth of mental grasp. From uniformity arises stagnation. Its final result is a dead pause in mental advancement. Variety of influences and conditions alone can yield a healthy and vigorous growth of thought. The movement of the national mind in any one line must soon cease. Its limit is quickly reached, unless it be aided by development in other directions. China affords us one example of this. There the religion is the worship of ancestors, or the Buddhistic atheism; the learning is the ethics of Confucius; the government is a patriarchal despotism. Religion, learning, and political institutions are thus innately prosaic; there is nothing to arouse the imagination; the mind of the whole people has become hereditarily stagnant through its ages of continuance in this state. In India, on the contrary, the imagination has been fostered at the expense of the reasoning faculties; literature, religion, and political relations are full of an unpruned growth of fancy; and the historical works, which form the basis of the literature of practical China, are unknown in imaginative India.

Such are some of the results of an isolated national development. Progress, in such nations, can not proceed far; for the mind, to attain its best results, must unfold all its faculties together. These strike fire from each other, and produce a genial flame where otherwise would be but smoldering embers. Every separate nation is subject to special conditions. It gains laws, customs, and possessions in accordance therewith. A number of isolated nations is equivalent to a number of separate individuals, each content with his own range of experiences and stock of ideas, and refusing, through prejudice or bigotry, to accept those of others. But when once individuals intimately mingle, and begin to compare thoughts and interchange ideas, a rapid mental growth takes place in each. A similar mental contact is not easy between nations. Isolation and national prejudice form barriers over which thought can but slowly make its way. Yet, evidently enough, were nations, after attaining the limit of progress in their special lines, to be thoroughly mingled, each falling heir to the mental growth of all the others, a sudden and rapid intellectual progress might well be achieved, hosts of new ideas arising from this grand influx of new experiences. In barbarian and semicivilized communities such an intermingling proceeds but slowly in times of peace. A certain degree of intercommerce and of emi-

gration may exist. But emigration under barbarian conditions does not usually bring peoples into contact, except it be the harsh contact of war. The only peaceful contact is the commercial one. Merchants, undoubtedly, in early times penetrated foreign tribes and nations, and brought home, in addition to their wares, stories of what they had seen and learned abroad. But the merchants were too few, too ignorant and prejudiced, and too little given to observation, to spread much useful information in this way; and their peoples were too self-satisfied to give up any customs and beliefs of their own for those thus brought them.

How, then, could any effective result from national contact be produced? In primitive times the only effective agency must have been that of war. Destructive as this is in its results, it has the one useful effect of thoroughly commingling diverse peoples, bringing them into the closest contact with each other, and forcing upon the attention of each the advantages possessed by the other. The caldron of human society must be set boiling before its contents can fully mingle and combine. War is the furnace in which this ebullition takes place, and through whose activity human ideas are forced to circulate through and through the minds of men.

But there is a special cause that renders war peculiarly effective in this direction. In every war there are two peoples to be considered, the invaders and the invaded. The latter remains at home, on the defensive, its government intact, its prejudices condensed by hatred of the invaders, its people strongly bent on both mental and material resistance. The invaders, on the contrary, not only leave their country behind them, but they leave its laws and conditions as well. They march under new skies, over new soils, through new climates. They come into the closest contact with new customs, laws, and conditions. And their local prejudices only partially march with them. The laws of the peaceful state are abrogated in the army. Its members are brought under other laws and disciplines. Religious influences weaken. A sense of liberty fills the mind of the soldier; expectancy arises; new hopes and fears are engendered; the old quiet devotion to law becomes a tendency to license.

Thus the mind of the soldier is in a state essentially unlike that of the peaceful citizen. The one is heated where the other is cool; expectancy in the one replaces the fixed prejudice of the other; a tendency to license and insubordination in the one replaces the law-abiding disposition of the other. The intellect of the soldier is therefore in a state rendering it a quick and ready solvent of new experiences. All its fixity of ideas is broken up, the deep foundations of its prejudices are shaken, it is in a receptive condition; fresh thoughts readily pass the broken barriers of

its reserve, it is freely open to ideas which it would have sternly refused in its cold, unsolvent, peaceful stage.

For this reason we find races which have dwelt long in self-satisfied barbarism suddenly leaping into civilization when they assume the rôle of conquerors. The savage hordes of Timur developed, in a few generations, into the comparatively civilized Mogul people of India. From the Saxon pirates who conquered England an Alfred the Great soon arose. The Norman invaders of France quickly threw aside their barbarism and emerged into chivalry.

This rapid change in mental conditions is not displayed by conquered nations. They remain sullen and obstinate. Though conquered physically, they continue mentally on the defensive. Yet the mental resistance of a subject people to their conquerors is only temporary. There is nothing more difficult than to raise fixed barriers in the mind against the influx of thought. The conquerors force on their subjects new social customs and new political institutions. No one can hinder himself from thinking and comparing, and the mind involuntarily opens to take in the advantageous ideas which may be thus presented to it. It is usually religious infusion that is longest resisted. Yet this, too, makes its way rapidly if there is a strong effort to enforce it. Witness the quick outflow of Mohammedanism through the conquered nations of Asia and Africa.

The results of invasion in this direction depend largely on the comparative civilization of the conquerors and the conquered. If a barbarous people overflows a civilized, the mental level of the conquerors is sure to be raised, but that of the conquered is very likely to be lowered. Yet the result is not a mean between the two grades of advancement; for ideas are hard to kill out. Unlike material possessions, they are capable of unlimited duplication. An idea is the one human possession that can be at once kept and given. Thus the ideas of the conquered infuse themselves irresistibly into the minds of their barbarian conquerors, becoming the mutual property of both peoples. If the conquering race be the most advanced, the process is somewhat different. They are likely to avail themselves of all the good they can obtain from the subjected people, and usually endeavor to force upon them their own form of mental discipline and social organization. Resistance to this influence is ineffective if the subjection be long continued. Roman thought and Roman civilization followed Roman conquest over half the ancient world. And when Rome was finally overflowed by barbarians, the persistent Roman thought exercised its lifting force on these conquering tribes, gradually reproducing the downtrodden civilization.

Another consideration naturally flows from the above review

of war as a civilizing agency. This is, that the greater the diversity in conditions between two warring nations, the greater is their mutual benefit. Civil wars usually yield but small results in this direction. Few new experiences are gained. It is but the commingling of two similar fluids. Yet in a case like that of our American civil war, where the existence of widely different conditions in two opposed sections of the country is the determining cause of the war, very important advantages to civilization may be gained. It would have taken many years of peace to produce as strong a feeling of the moral obliquity of slavery as was produced in four years of war. The heated minds of our people received the doctrine of abolitionism as a river of new thought, where before it had been but a trickling rivulet. And the overflow of this new thought is gradually making itself felt in the South, despite the fact that the conquerors have left them to their previous isolation.

Thus it is not only the soldier's mind that is heated and receptive; the same condition, in a lesser degree, exists in the nation for whose benefit the army is fighting. The souls of the people march, if their bodies do not, with the army. They are excited, hopeful, eager to participate in its booty, and ready to be influenced by its experiences. And when the conquerors return with spoils in their hands, and new thoughts, beliefs, and aspirations in their minds, they mingle intimately with a people eager to participate in their gains, and in a mental condition highly receptive to their new ideas. The more diverse these from the previous mental state of the people, the greater is the warping influence upon the national mind, and the more decided are the new conceptions attained. Nor in any such case does the conquering race simply lift itself toward the level of the conquered. If we cause oxygen and hydrogen to combine, the result is not oxygen or hydrogen, but water. And, in like manner, the mingling of two diverse grades of thought yields a compound that resembles neither of its constituents, but is a new phase of civilization, a positive step forward in progress.

Thus the world progressed through its long ages of partial civilization. The combined experiences of the members of a tribe yielded a certain degree of advancement, and there stopped. Each tribe differed from all others to the extent that its experiences and their resulting ideas differed. During peace the tribes repelled each other and remained intact, each with its special form of mental progress. In war they overflowed each other, greatly diversified thoughts and habits were brought into intimate contact, new ideas were engendered from the mixture, new forms of civilization arose. And as war was almost incessant, so these new products of thought were constantly brought into existence.

Nomads became agriculturists through conquest; but the habits and ideas gained in a nomadic life mingled with those of the conquered agriculturists, and yielded a new and superior result—superior because based on a wider range of experiences and bringing a greater number of elements into the problem of social development. Mountaineers brought down their ideas to combine them with those born of the plain. Deserts and river valleys poured their common thought results into new and more comprehensive minds. The great ebullition went on. East mingled with west, north with south, mountain with plain, seashore with interior; men's thoughts fused and boiled incessantly; new compounds constantly appeared; the range of ideas grew wider and higher; and mental development steadily advanced—though over the ruins of empires and through the ashes of man's most valued possessions.

It was a destructive process. Life vanished, wealth perished, nations disappeared. But mind remained, and mind infused by every invasion with new ideas. The raw material of progress continued undestroyed. Material production is only inorganic substance poured into the mold of an idea. Its loss is no permanent deprivation while the idea remains. Its destruction is a positive gain if it has aided in yielding a crop of fresh and superior ideas.

The considerations above taken seem to prove that war has been an efficient civilizing agent, despite its cruelty and destructiveness. Nor has its good influence been physical and intellectual only; it has been moral as well. In truth, intellectual development can not go far without instigating moral advancement. But war has a more immediate ethical influence through its influence in combining tribes into nations, nations into empires. It widens human sympathies, brings greater bodies of people under the softening influence of fellow-citizenship, extends more widely the sentiment of human brotherhood, and overcomes that feeling of hostility with which tribesmen are apt to regard all mankind beyond their narrow borders.

War would therefore appear to have benefited man in the past alike physically, mentally, and morally. It can not be claimed to be a necessary agent for these purposes in the enlightened nations of the present. It has been replaced by more efficient civilizing agencies, whose character we now need to consider. In modern times nations have learned how to avail themselves of each other's advantages without going to war for them. Commerce, travel, and emigration have gone far to overcome national isolation, and a peaceful commingling of peoples has taken the place of warlike invasion.

Commerce lay at the foundation of Grecian enlightenment.

The interchange of products is necessarily accompanied, to some extent, with an interchange of ideas. The feeling of curiosity reached a high point of development among the Greeks. It was the thirst *to know* which sent old Herodotus into the heart of hostile nations, and which is sending thousands to-day, in quest of knowledge, through the highways and byways of the world. Greece first fairly set in train this mental commerce. But the peaceful interchange of thought has grown immensely since the Grecian days, the whole world is being ransacked for old ideas and new experiences, and the thought stock of the several nations is gradually becoming a general thought stock, the freehold property of the world.

It is unquestionable that trading nations which have reached a certain degree of mental advancement are efficient agents in propagating civilization. There are several instances of this in the history of the past, but in most of such cases commerce was aided in its effects by colonization. It was not the movement of a few isolated merchants, but of extensive colonies, that produced the commingling of thought, with its useful results. The Phœnicians were the first great trading nation of whom we have any record; and they were the first to emerge into civilization under peaceful influences. The Greeks followed them in this field, and the lofty enlightenment of Athens is more to be ascribed to its commercial activity, its colonizing spirit, and its free reception of the best minds from other nations than to its warlike vigor and success. In more modern times we have had successively the Venetians, the Genoese, the Spaniards, the Portuguese, the Dutch, and the English advancing into commercial activity and, with it, into phases of enlightened energy in close accordance with the width and character of their commerce.

We no longer have to fight our way into the thoughts of the world. Every step of mental development made by an exterior people is becoming our own without need of its being taken by violence. We pick and choose at will throughout the races of mankind, digest what we thus consume, assimilate the good, avoid the evil, and widen our minds continually in the process. If it is something to learn what good exists unknown to us, it is also something to know what evil exists. A knowledge of good and evil alike is essential to human progress. And this process is in no sense a destructive one. In war not only possessions are destroyed, but to some extent ideas as well. It is only the remnants that enrich the conquering race—the methods of material production, the religions and philosophies, the rigid laws and customs among which they settle down and which they are forced to assimilate.

Modern progress is not gained by the gathering up of the relics

of a conflagration. It is a whole, healthy, and complete development, a method full of infinite possibilities. Yet it has its apparent drawbacks. The minds of people working peacefully at home are not in the recipient state of that of the soldier, who has broken the chains of law and habit and grown singularly porous to the reception of new ideas. Local prejudices dwell at home with localized people. Knowledge has to fight its way through a thick crust of self-satisfied home partisanship. Men must come into contact with each other if conservatism is to be eliminated. They are fortunately coming more and more into peaceful contact with each other. Modern facilities are rendering habits of travel more general. There is as much peaceful movement now as there was warlike movement of old. The stay-at-home society is yearly losing membership.

And this process is wonderfully aided by another instrumentality. Men's bodies on longer need to touch for their ideas to come into contact. Ideas themselves are on their travels. The whole world, in a contracted sense, lies before every man at his breakfast table. The newspaper, aided by the telegraph, is a most powerful civilizing agent. In books not only the thought of the existing world, but a condensed epitome of the thought of all the past, is placed before the reading public. The library is the great granary of ideas. The press is the brain of the world, the grand receptacle of its thoughts.

Thus, in a wider sense than ever before, we travel and learn. Our souls travel while our bodies are at rest. The whole world is harvesting all the experiences and ideas gained by any portion of mankind. It is not the destructive harvesting of war, but the careful harvesting of peace. And prejudice—the mental isolation which has succeeded to national isolation—is breaking down before it. We are growing more and more receptive. The world's mind is becoming strikingly porous to new thought. We are cutting loose from fixity of belief, rigidity of custom, and devotion to authority, and growing mentally flexible, inquiring, and rebellious against bigotry. The reign of faith is giving way to the reign of reason.

And in this modern mode of development ethical evolution comes actively into play. Human progress has its three phases—the physical, the intellectual, and the moral. The last, the highest of all, was but imperfectly provided for in the old civilizing agencies. War has a brutalizing tendency. Only in peaceful development can moral progress fully display itself. As the highest moral advancement of mankind has seemed to keep pace, perhaps necessarily, with the highest intellectual development, it was undoubtedly to some extent favored by war. Certainly, in the warring nations of Europe morality has reached a far higher stage

than in the peaceful nations of eastern Asia, essentially, no doubt, through the influence of Christianity, but largely through the development of the intellect, the disappearance of local prejudices, and the extension of human sympathy arising from the formation of great nations.

War still exists, but it has largely lost its function as a civilizer so far as enlightened nations are concerned. New and superior agencies are at work, and the injury done by war now looms far above any good it is likely to accomplish. Yet its active power in the spread of ideas continues, as in the notable instance I have already named—that of the rapid growth of abolition sentiment in the North during the American civil war. Possibly future useful effects in the same direction are still reserved for war, though it is to be hoped that man may henceforward rest content with the more desirable, if slower, results of peace.

SKETCH OF DAVID HOSACK.

IN the early part of the nineteenth century no citizen of New York was held in higher honor than was De Witt Clinton. Closely associated with Clinton in the leadership of the civic life of the day, but holding rigidly aloof from politics, was Dr. Hosack. "It was not infrequently remarked by our citizens," said his pupil and associate, John W. Francis, "that Clinton, Hosack, and Hobart were the tripod on which our city stood." Dr. Hosack was one of the founders of the New York Historical Society and its president from 1820 to 1828. He was also instrumental in founding an art society, was prominent in various scientific, literary, and humane undertakings, and, if his lead had been followed, New York would have to-day a botanic garden equal to any in a European metropolis.

DAVID HOSACK was the eldest of seven children, and was born August 31, 1769, in the house of his maternal grandfather, No. 44 Frankfort Street, New York. His father, Alexander Hosack, was a native of Morayshire (Elgin), Scotland. Having entered the British army, he was, at the age of twenty-one, serving as an officer in the artillery. He came to America in the force under General Sir Jeffrey Amherst, and was at the retaking of Louisburg. April 1, 1768, he married in New York Jane, daughter of Francis Arden. Her father's family came from England, while that of her mother belonged to that valuable contingent of Huguenot citizens which America received as a consequence of the revocation of the Edict of Nantes.

Young David, after receiving the ordinary elements of educa-

tion, was placed at fourteen or fifteen years of age in the academy of the Rev. Dr. Alexander McWhorter, of Newark, N. J., where he pursued the study of Latin and other usual branches and began to learn Greek. But as Dr. Peter Wilson, of Hackensack, was a more distinguished teacher of the latter tongue than Dr. McWhorter, David was transferred to his academy in 1785. The next year he entered Columbia College, remaining in that institution until the middle of his junior year. He had also private tutors in the classics and the French language. In the beginning of the junior year, finding his time not fully occupied, he took up the study of medicine as a private pupil under Dr. Richard Bayley. "He had scarcely begun his studies," writes his son,* "before the celebrated 'Doctors' Mob' occurred, which threatened serious results to those concerned; it arose in consequence of the imprudence of some of the students carelessly pursuing dissection in the building upon the site since occupied as the New York Hospital. This mob caused many of the professors to absent themselves from the city and others to seek shelter in the city jail. Mr. Hosack, with the rest of the students interested, learning that the mob had seized upon and demolished the anatomical preparations found in the lecture room above referred to, repaired immediately to Columbia College,† with the view of saving such specimens as were to be found in that institution. Before reaching the college, however, and when on his way in Park Place, he was knocked down by a stone striking him on the head; he would in all probability have been killed had it not been for the protection he received from the neighbor of his father, Mr. Mount, who was passing at the time and took care of him."

In the fall of 1788 young Hosack entered the senior class of the College of New Jersey at Princeton in order that he might the sooner complete his collegiate course and devote his whole attention to the study of medicine, to which he had become ardently attached. "Having finished my course at Princeton," he says in some memoranda that he left for the benefit of his children, "I returned to New York and resumed my favorite medical studies, to which I now gave my undivided attention, availing myself of every advantage which the city at that time presented. I attended the lectures on anatomy and physiology delivered by Dr. Wright Post, those on chemistry and practice of physic, by Dr. Nicholas Romayne, and the valuable course on midwifery and the diseases of women and children, by Dr. Bard.

* Dr. Alexander E. Hosack, in a biography contributed to the Lives of Eminent American Physicians and Surgeons of the Nineteenth Century, edited by Samuel D. Gross, M. D. From this biography most of the facts for the present article have been drawn.

† Then in College Place.

I also attended the practice of physic and surgery at the almshouse, which then offered the only means of clinical instruction in this city; they were, however, very ample, the house being daily visited by Dr. Post, Dr. William Moore, Dr. Romayne, and Dr. Benjamin Kissam."

There was then no institution in New York empowered to grant the degree in medicine, the medical faculty of Columbia, formerly King's College, having been broken up by the Revolution. So, after a year of private study, Hosack proceeded to Philadelphia and enrolled at the medical school of the University of Pennsylvania, where Drs. Shippen, Rush, Kuhn, and Wistar were then among the professors, and in the summer of the succeeding year obtained his medical degree. In the same year he married at Princeton Miss Catharine Warner, a young lady of great worth, to whom he had become attached while pursuing his collegiate studies.

By the advice of Dr. Rush and others whom he consulted, Dr. Hosack settled first at Alexandria, Va., which place he believed was to be the capital of the United States. The practice that he acquired here, although considerable, was not satisfactory to him, and after a year's residence he returned to New York. He now determined to supplement his medical studies abroad. "Observing the distinction," to quote his own words, "which our citizens at that time made between those physicians who had been educated at home and those who had had additional instruction from the universities of Europe, and knowing how little property I had reason to expect from my parents, I found that my chief dependence was upon my own industry and increasing attention to the profession I had chosen as the means of my subsistence: my ambition to excel in my profession did not suffer me to remain insensible under such distinction. Although it was painful for me to think of leaving my family, consisting then of a wife and child, I accordingly suggested to my father the propriety of my making a visit to Europe, and of attending the medical schools of Edinburgh and London. He at once, with his characteristic liberality, acquiesced in my views and wishes. In August, 1792, leaving my family to the care of my parents, I took passage for Liverpool."

After spending a few days in Liverpool he proceeded to Edinburgh, where he attended the medical lectures at the university during the following winter. In the spring, after a visit to his father's birthplace, where he met two uncles and other relatives, and to some other places in Scotland, he repaired to the metropolis and entered as a pupil of St. Bartholomew's Hospital. He also frequently visited other hospitals when any important surgical operations were performed, surgery being the favorite subject of

his pursuit; he nevertheless did not neglect the collateral branches of medical science.

It was during this stay abroad that his interest in botany sprang up. "Having," as he says, "upon one occasion—while walking in the garden of Prof. Hamilton, at Blandford in the neighborhood of Edinburgh—been very much mortified by my ignorance of botany, with which his other guests were familiarly conversant, I had resolved at that time, whenever an opportunity might offer, to acquire a knowledge of that department of science. Such an opportunity was now presented, and I eagerly availed myself of it. The late Mr. William Curtis, author of the Flora Londinensis, had at that time just completed his botanic garden at Brompton, which was arranged in such a manner as to render it most instructive to those desirous of becoming acquainted with this ornamental and useful branch of a medical education. Although Mr. Curtis had for some time ceased to give lectures on botany, he very kindly undertook, at my solicitation, to instruct me in the elements of botanical science. For this purpose I visited the botanical garden daily throughout the summer, spending several hours in examining the various genera and species to be found in that establishment. I also had the benefit once a week of accompanying him in an excursion to the different parts of the country in the vicinity of London. Dr. William Babbington, Dr. Thornton, Dr. (now Sir) Smith Gibbs, Dr. Hunter, of New York, the Hon. Mr. Greville, and myself composed the class in these instructive botanical excursions, in the summer of 1793.

"By Mr. Dixon, of Covent Garden, the celebrated cryptogamist, the '*maximus in minimis*,' as Mr. Curtis has very properly and facetiously denominated him, I was also initiated into the secrets of the cryptogamic class of plants. In the spring of 1794 I also attended the public lectures of botany delivered by the President of the Linnæan Society, Dr. (now Sir) James Edward Smith; and by the kindness of the same gentleman I had access to the Linnæan Herbarium. I spent several hours daily for four months examining the various genera and the most important species contained in that extensive collection." The acquaintance thus begun with Sir James Edward Smith ripened into an affectionate friendship, and a correspondence was begun that ended only with Smith's life.

In the course of the winter of 1793–'94 Dr. Hosack embodied certain Observations on Vision in a paper which he communicated to the Royal Society. It was published in the society's Transactions for 1794, and brought him, after due examination by a committee, the thanks of the society. A theory was in some vogue at the time that the power of accommodation in the eye

resided in the crystalline lens. Hosack maintained the opposing theory that it depended upon the external muscles. His paper contained many original views, and its statements were supported by experiments that he had made upon himself and others.

He returned to New York in 1794 by the ship Mohawk, the passage lasting fifty-three days. On the voyage typhus fever made its appearance and became very general, particularly among the steerage passengers. Dr. Hosack being the only physician on board, was called upon to attend the stricken ones, and was wonderfully successful, not losing a single case. His services were duly appreciated by all, as was evinced by the unsolicited vote of thanks published in the daily papers when the ship reached port.

Taking up his residence in New York city, Dr. Hosack, at the age of twenty-five years, began again the practice of his profession under the most favorable auspices. Mr. Thomas Law, who had been a fellow-passenger on the Mohawk, introduced him to many of his acquaintances, among whom were General Hamilton and Colonel Burr. He soon became the family physician to these distinguished persons. In 1795 he was appointed Professor of Botany in Columbia College, for which position his diligent application to this science in London had admirably fitted him. At the end of his first course he published a syllabus of his lectures, afterward inserted in his Medical Essays. In 1795, also, the yellow fever reached New York, and the violence of the epidemic afforded ample opportunity to young medical men to distinguish themselves. Dr. Hosack at this time attracted the especial attention of Dr. Samuel Bard, one of his former preceptors, who soon after took him into partnership. This was a preparatory step to Dr. Bard's retiring from the profession, which he did three or four years later, leaving Dr. Hosack in the enjoyment of an extensive and profitable practice.

Having lost his infant son during his absence in England and his wife not long after his return, Dr. Hosack married, December 21, 1797, Mary, daughter of James and Mary Darragh Eddy, of Philadelphia. By this marriage he had nine children.

Upon the death, in 1797, of Dr. William Pitt Smith, his chair of Materia Medica in Columbia College was assigned to Dr. Hosack, in addition to the one of Botany already held by the latter. He continued to fill these two professorships until 1807, when the College of Physicians and Surgeons of the State of New York was established, in which he was chosen Professor of Surgery and Midwifery. He soon, however, relinquished this chair for that of the Theory and Practice of Physic and Clinical Medicine. The Analectic Magazine for 1814 contained a notice of an introductory lecture given in the last-named chair, which had been published. It says that, after an opening statement on another

matter, "Dr. Hosack proceeds to point out what he deems the proper method of cultivating the science of medicine. He recommends the inductive system of philosophizing as the only sure means of acquiring correct methods in science, and enforces the same by the celebrated examples of Bacon, Boyle, and Newton in physics, of Reid, Bentley, and Stewart in metaphysics, and of Hippocrates, Sydenham, and Boerhaave in medicine."

Meanwhile Dr. Hosack had become prominently known for his success in the treatment of yellow fever, which had visited New York in four successive summers, beginning with 1795, and afterward in 1803, 1805, 1819, and 1822. On many occasions, when disease suspected to be yellow fever broke out, he was called upon by the Board of Health of New York for a report as to its real nature, for if the fears of his fellow-citizens were groundless his statement would be sure to allay them.

Of Dr. Hosack in the professorial chair, Dr. Minturn Post, one of his pupils, has said: "In no respect was Dr. Hosack more remarkable than as a lecturer; gifted with a commanding person and a piercing eye, of an ardent temperament and of strong convictions, his manner of treating the various subjects connected with his professorship was at once bold, impressive, and eloquent. . . . His great object was to direct the student to the importance of the subject under examination, to lead him by his eloquence, and to rivet his attention by his earnestness, and no man ever succeeded better as a public lecturer in attaining these results. . . . Dr. Hosack was gifted with a fine, sonorous voice, great play of expression, and a remarkable vivacity of manner—qualities which, being as it were contagious, begat in his youthful auditory a kindred sympathy." In closing his account above quoted Dr. Post remarks: "He lived in memorable times, before the great men of the Revolution had passed away; had seen and conversed with the most eminent of the age; had listened to the inspired song of Burns, tuned to sweet cadence, from his own lips; was intimate with Rush, and Gregory, and Sir Joseph Banks, and was the friend of Clinton and Hamilton." The friendship of Hamilton was probably won for the most part by his success in saving the life of a son of the general sick with scarlet fever, whose case for a time was deemed hopeless. This friendship was conspicuous on every occasion, and was terminated only on that day when Dr. Hosack accompanied Hamilton across the Hudson River to his fatal duel with Colonel Burr.

Dr. Hosack is often mentioned as one of the leading promoters of science of his time. "His love of botanical science," says his son, "induced him to found the Elgin* Botanic Garden, which

* So named after the village in Scotland where his father was born.

he did at his own individual expense, as early as 1801. It was situated about three miles and a half from the city of New York. It consisted of about twenty acres of land on the middle road.* It was selected from its varied soil as peculiarly adapted to the cultivation of the different vegetable productions. The grounds were skillfully laid out and planted with some of the most rare and beautiful of our forest trees. An extensive and ornamental conservatory was erected for the cultivation of tropical and greenhouse plants, as well as those devoted to medical purposes, more especially those of our own country.

"At this time there were under cultivation nearly fifteen hundred species of American plants, besides a considerable number of rare and valuable exotics. To this collection additions were made from time to time from various parts of Europe as well as from the East and West Indies. It was the intention of the founder of this beautiful garden, had his means been more ample, to devote it to the sciences generally, more especially those of zoölogy and mineralogy. This, however, he was compelled from want of fortune to relinquish, hoping that the State of New York would at some future day be induced to carry out the plan as suggested by him similar in all respects to that of the Garden of Plants in Paris; but in this he was disappointed. The State purchased the garden from him, but, like many other public works unconnected with politics, it was suffered to go to ruin. While it was in his possession it afforded him many a pleasant hour of recreation, and served to abstract him from the cares and anxieties of an arduous profession." Frederick Pursh, author of the Flora Septentrionalis, was for several years curator of this garden.

A jail society, which had existed in New York to supply provisions to prisoners for debt, was developed by Hosack into the Humane Society, with broader aims and means. The City Dispensary received no less his care and attention. He vigorously advocated a separate hospital building for contagious diseases, the strict enforcement of quarantine regulations, the substitution of stone piers for wooden ones, and urged that the city's sewers should discharge at the outer ends of the piers instead of at the bulkhead line.

His friends often wondered that Dr. Hosack found time to contribute so much as he did to the literature of his profession. At an early period he began the publication of the Medical and Philosophical Register, a quarterly journal, in which Dr. John W. Francis was associated with him. He afterward published

* The location is given in Mrs. Lamb's History of New York as lying between Fifth and Sixth Avenues and stretching from Forty-seventh to Fifty-first Streets.

three volumes of his Medical Essays, containing occasional addresses, introductory lectures to his regular courses, many practical papers on medical subjects, etc. He also published an extensive appendix to a work on the Practice of Medicine, by Dr. Thomas, of Salisbury, England. Adopting the nosological arrangement as a system best calculated to illustrate diseases, he was induced to prepare a work on that subject, which ran through several editions.

Botany was not the only branch of science in which he became interested while abroad. To quote from a sketch of his life by a friend: "He attended in the winter of 1793–'94 the first course of lectures on mineralogy that was delivered in London by Schmeisser, a pupil of Werner. With this additional knowledge of mineralogy, which Dr. Hosack had begun to study at Edinburgh, he continued to augment the cabinet of minerals which he had commenced in Scotland. This collection was brought by him to the United States, and was, we believe, the first cabinet that crossed the Atlantic; it was afterward deposited in Princeton College, in rooms appropriated by the trustees, but fitted up at the expense of the donor, similar to those at the *École des Mines* at Paris. To render this donation immediately useful, it was accompanied by a collection of the most important works on mineralogy."

Having a large circle of friends and acquaintances, and being fond of company, Dr. Hosack used to set apart his Saturday evenings for entertaining them. "Surrounded by his large and costly library, his house was the resort of the learned and enlightened from every part of the world. No traveler from abroad rested satisfied without a personal interview with him; and, at his evening *soirée*, the *literati*, the philosopher, and the statesman, the skillful in natural science and the explorer of new regions, the archæologist and the theologue met together, participators in the recreation of familiar intercourse." Many a distinguished American and many a foreign visitor, coming with a letter from some European friend of Hosack, has left on record his delightful experience in a visit to the doctor, either at his city house or his place in the country.

Of the scientific honors most prized by Americans in his day —membership in European societies—Dr. Hosack had a goodly share. He also received the honor of having a genus of plants named for him. The various species of *Hosackia*, of which there are some thirty, are herbs and shrubs growing in the Southern and Southwestern States and in Mexico.

His second wife having died, Dr. Hosack married Mrs. Magdalena Coster, widow of the Holland merchant, Henry A. Coster. Some time after this event he retired from his profession and

spent the rest of his life, except the winter months, on the beautiful estate at Hyde Park, on the banks of the Hudson, which he had owned for a number of years. Here he devoted himself to agriculture and to growing plants of botanical interest. "He carried with him," his son remarks, "the same ardor and zeal which had been so characteristic of him in his professional career. He introduced into the country many of the finest breeds of cattle, sheep, and swine, which he imported at great expense from abroad. The grounds were cultivated in the best possible manner, and the most esteemed fruits and vegetable productions of the country were made to thrive in the greatest luxury possible."

In the autumn of 1835 Dr. Hosack removed as usual to his city residence, and a few weeks after was seized with apoplexy which terminated his existence. One morning in December he went out and did some business errands, and on his return home found he was paralyzed in his right arm. His speech was also affected. He received immediate attention from his son, Dr. A. E. Hosack, and later from several of his professional friends. But their efforts were of no avail. His symptoms became worse, and four days after the attack, on December 22d, he passed away. His body was placed in the family vault in the marble cemetery in Second Street.

One of the surest ways in which an eminent man can cause his influence to live after him is in training up younger men to lives of usefulness. This Dr. Hosack was constantly doing. "I can scarcely recollect the time," says his son, "when he was without some such *protégé*." At one time it was the son of a New York carpenter, who unfortunately fell a victim to his devotion to yellow-fever patients in the epidemic of 1798. At another it was a young Frenchman, who without means, had come to America to study its flora, his family having been forced to leave France on account of the Revolution there. Dr. Hosack took him into his family and educated him as a physician. He returned to France and became eminent as a botanist. This was Prof. Delile, who accompanied Napoleon to Egypt as the botanist of his scientific corps, and was afterward superintendent of the *Jardin des Plantes* at Montpellier. Among Dr. Hosack's regular pupils at the College of Physicians and Surgeons was John Torrey, and many other students who heard his lectures at the medical school or at Columbia College had whatever of inclination toward botany they possessed greatly quickened by the enthusiasm and eloquence of Dr. Hosack.

EDITOR'S TABLE.

SCIENCE AND NESCIENCE.

IT is a very long time since the discovery was first made that the processes of human thought are only valid within limits; and it might be supposed that all the consequences which could properly be deduced from that fact had long ago been drawn and reduced to their true value. Yet every now and again it seems to strike some thinker with new force that the human mind is not all-comprehending; and it is a singular thing that, when this happens, we are nearly always asked to take back some view or doctrine which we had previously discarded, or at least laid aside, as destitute of proof and not in harmony with the general body of our knowledge. In other words, because we can not understand or measure everything, we must consider that there is a door perpetually open into some fourth dimension, as it were, through which may freely enter beliefs of the most fantastic kind, and such as, judged by the laws of our own familiar three dimensions, we should utterly refuse to accept. No other than this is the lesson which Mr. Balfour attempts to teach in his much-discussed work, The Foundations of Belief. He proves, most unnecessarily, that science can not reach the absolute origin of things, and that, when we get back to such ultimate conceptions of matter and force as we are capable of forming, we do not discover those finished products of human evolution, moral authority and the sense of beauty. His work is described on the title-page as being "introductory to the study of theology," and the author makes it plain that what he would have us do is, on the ground of the insufficiency of human reason, to accept a system of theology, preferably the Christian, which, while carrying us back to the origin of all things, will provide a basis for those moral beliefs and sentiments which are essential at once to the dignity of the individual and the cohesion of society, but which science, as he holds, can neither explain nor justify.

Now, we have no objection whatever to Mr. Balfour's conclusion that people should cherish some form of religious belief, but we think he is ill advised in trying to prove that, because science is weak, theology (*his* theology) is probably strong. Whatever weakness attaches to science attaches to it by virtue of the limitations of the human mind, which, as Matthew Arnold says,

> "A thousand glimpses wins,
> But never sees the whole."

Science, as we have often said in effect, is simply the product of the striving of the mind after exact knowledge; and by exact knowledge we mean knowledge brought more and more into conformity with the totality of human perceptions. If Mr. Balfour could convict science of using illegitimate processes or of endeavoring to stereotype unverified or imperfectly verified doctrines, he might very properly bid us look elsewhere for guidance; but this he nowhere does. He is well aware that civilization is rich to-day with the garnered results of a score of separate sciences, and that men are coming and going and living their lives in a well-grounded assurance that, in the main, what science teaches as true is true, and that work done on scientific principles will stand.

Science might perhaps conveniently be defined as the kind and extent of knowledge which the constitution of the human mind permits us to have; and, so viewing it, we certainly fail to see what theology can do for us in the way of bringing knowledge or rational belief within our reach that science can not do. Will it be said that, while science reflects the limitations of the human mind, theology does not do so? History would certainly not confirm such a contention. Science uses imagination, but keeps it, or tries to keep it, under control; theology, if we judge by the systems that have held sway in the past, has used imagination, has hardly even tried to control it, and has often been completely overmastered by it. In ancient Egypt, according to Erman, "we find a mythology with myths which are absolutely irreconcilable existing peacefully side by side; in short, an unparalleled confusion (which) . . . became ever more hopeless during the three thousand years that, according to the pyramid texts, the Egyptian religion flourished." Yet the books in which this religion was set forth were so sacred that "even the gods themselves were supposed to wash seven times" before reading them. "The lively Grecian," as we know,

> "In a land of hills,
> Rivers and fertile plains and sounding shores,
> Under a cope of variegated sky,
> Could find commodious place for every god";

but the myths he wove about those gods were of so doubtful a moral tendency that Plato was opposed to allowing them to enter into the education of youth. Of the sacred rites of the Etruscans the historian Mommsen says that "their prevailing characteristics are a gloomy and withal tiresome mysticism, a ringing the changes on numbers, soothsaying, and that solemn enthroning of pure absurdity which at all times finds its own circle of devotees." The Latin religion, the same high authority tells us, had a respectable origin in the attempt to spiritualize and generalize the phenomena of Nature and the duties and functions of everyday life; but, by a gradual process of change, it "sank into a singular sobriety and dullness, and early became shriveled into an anxious and dreary round of ceremonies."

If science therefore can not lead us into all truth, it is tolerably clear that theology, as the world has heretofore known it, can not save us from all error, but on the contrary is exposed to all the perversions which an unchecked use of imagination can entail. The task to which Mr. Balfour has committed himself is to show that the particular system which he would recommend is free from the imperfections and, so to speak, organic weaknesses of all other systems, and that it stands forth as an unimpeachable authority in all those matters upon which science is incapable of instructing us. The accomplishment of this task, it is needless to say, will be watched with much interest by every reader of Mr. Balfour's recent volume.

We may remark before concluding that we are not nearly as much troubled as Mr. Balfour evidently thinks upholders of "naturalism" ought to be, by the knowledge that the primary data of science do not afford any hint of the moral law or of the highly developed human emotions that are associated therewith. Neither does the atomic theory or molecular chemistry afford any hint of the wonders of organic life, which yet depend on molecular association. We might know all that is to be known in regard to the elements as elements without discovering the secret of the rose or of the tiniest

"flower in the crannied wall." But are we to abandon or disparage what we know about the chemical composition of the rose because there is that in its synthesis which eludes us? Or are we to refuse our admiration to the flower because its original elements promised no such revelation of beauty?

> "The world is what it is, for all our dust and din";

and the part of wisdom is to make the best of it. If there are those who think they discern a flaw in the title of the moral law, and on that account propose to trample it under their feet, all we can do is to keep our eye on such and see that the moral law is duly re-enforced by material sanctions. A writer of more than literary authority has described "the law" as "a schoolmaster" (literally, pedagogue or child-conductor) to bring us to the true source of instruction; and we may rightly infer that the external precepts which have more or less governed mankind in the past, by whatever authority promulgated, have had for their function to bring men to a recognition of the intrinsic moral quality of actions, and to incline them to choose good in preference to evil. The course of human evolution has brought us a developed moral sense; and the important question for us now is not whether that supreme faculty was foreshadowed in the pre-organic world, or whether it can be read into the atomic philosophy; but whether it is a living fact to-day, whether it is useful for guidance and whether obedience to it is an essential condition of happiness. The search for title-deeds is very well within limits; but there was a time when title-deeds were not, simply because the conditions did not call for them. The moral law is in possession, and will remain in possession, because it has become part of the constitution of human nature.

THE PATH OF SCIENTIFIC ADVANCE.

In an excellent article on the late Prof. Huxley, contributed by the eminent Professor of Physiology at the University of Cambridge to Nature, and reprinted in this number of the Monthly, we read that the "note" of the "new morphology," of which Huxley made himself so earnest and successful an apostle, was "not to speculate on guiding forces and on the realization of ideals, but to determine the laws of growth by the careful investigation, as of so many special problems, of what parts of different animals, as shown, among other ways, by the mode of their development, were really the same or alike." The result of the prosecution of research along this line, Prof. Foster says, has been the acquisition since the year 1850 of "a body of science touching animal forms both recent and extinct of which we may well be proud," and that altogether apart from the special discoveries which may be traced directly or indirectly to the influence of the Darwinian theory of natural selection.

We have thought it worth while to cite this dictum of the Cambridge professor as bearing somewhat closely on a recent discussion in these columns. A contributor who was dissatisfied with certain references we had made to the doctrine of design, put forward his own opinion to the effect that the time had now come for making design the Why? —the guiding principle—of research. Such is manifestly not Prof. Foster's opinion, or else, while commending Huxley for throwing in his lot with the "new morphology," he would certainly have hinted that there was a yet newer morphology, destined to

lead to still greater results, and the note of which was, specifically, speculation on "guiding forces and the realization of ideals." Of course, this newer morphology would only be the old pre-Darwinian speculation back again; and we think it is tolerably safe to conclude that such a reintroduction is not contemplated by the leaders in science to-day, and is in no wise a probable event.

The comparative study of animal forms resembles more or less all other comparative studies. It does not lead to the discovery of ideals in any sense, any more than does the comparative study of myths. We are merely led back from more developed to less developed forms, indicative of simpler conditions of life and a less varied play of the action of natural selection. We are no nearer to any "Why" when studying amœbæ than when investigating the structure of the highest vertebrates. The whole result of comparative biological study is to show us the order, and to some extent, the conditions of development of animal and vegetable structures, and to establish connections, affiliations, and homologies where, apart from the comparative method, no resemblances or correspondences of any kind could be detected. As our knowledge in any field of investigation attains a certain completeness, the imagination is impressed more and more with the wonderful unity of plan which prevails throughout the works of Nature; and at times we thrill as we catch, or seem to catch, the pulsations of universal life. These emotions come to us not in the search for ideals, but in that humbler search for facts and co-ordinating principles which some would have us forsake, as being altogether too humble and below our high prerogative as intellectual and moral beings. To us the world and humanity furnish an ample school for the training of our highest faculties, the religious not excluded. All depends on the spirit in which knowledge is pursued. Without grappling with problems that are in their nature insoluble, we may seek to adjust ourselves progressively to the highest knowledge we can attain, and thus to reach the highest and best self-development. If we do this, the path of knowledge will be for each one of us a path of ascent, and we shall find that, without any investigation of the Why, we have solved life's problem in the best possible manner.

THE AMERICAN ASSOCIATION AT SPRINGFIELD.

THE meeting of the American Association for the Advancement of Science this year was characterized by a calm studiousness which was promoted by the quiet but thrifty environment in which it was held. The address of the retiring president, although confined to the one science in which Dr. Brinton has won his chief eminence, was a model for such addresses, in that the whole of it could be "understanded of the people," while at the same time furnishing food for thought to the man of science. It is no doubt easier for an anthropologist to prepare such an address on his science than for the specialist in some other fields, for the science of man is no foreign ground to any intelligent human being. This was demonstrated by the continued interest and large attendance at the sessions of the Anthropological Section. The addresses of most of the vice-presidents dealt with broad aspects of the several sciences. That of Mr. F. H. Cushing, on The Arrow, was more like a special paper, but the expressions of interest on the part of his hearers showed that they found no fault with him on that score. The public has often been

told what great benefits industry receives from labors in pure science. It was a happy thought for Mr. William McMurtrie to point out to a scientific audience the benefits that the science of chemistry has derived from industrial operations. Those who listened to Vice-President William Kent's address on The Relation of Engineering to Economics carried away several valuable ideas, one being that the invention of machines has been of more economic importance than the division of labor of which the old economists made so much; another that America is far behind the Old World in the art of wasting human labor; and another that improved methods inflict more temporary loss on capital by destroying the value of machinery and appliances than upon labor by displacing workmen. Mr. B. E. Fernow, addressing the Section of Economic Science, ventured upon the debatable ground of governmental functions, but probably most of his audience accepted what he said in regard to the conservation of our forests and other natural resources. The papers read gave evidence of diligent research and had been in the main well sifted, although occasionally some newly fledged professor or garrulous veteran consumed more time than he should have. Time limits rigidly enforced by the several presiding officers might be worth trying in order to give more snap to the proceedings and increase the value of the association to the best workers. The only remarkable discovery announced in the course of the meeting was the finding of another implement in the glacial gravels, which strengthens the view that man lived in America either during or immediately after the Glacial period. The implement was exhibited and described by Prof. G. F. Wright, who has become the leading exponent of this view. The attendance was an average number, and probably included a smaller proportion of sightseers and a greater one of workers than when the meetings are held in larger cities.

Next year the association will hold its fourth meeting in Buffalo, further strengthening the precedent of a decennial visit to that city, and Prof. E. D. Cope will preside. The vice-presidents elected are: (A) Mathematics and Astronomy—William E. Story, of Worcester; (B) Physics—Carl Leo Mees, of Terre Haute, Ind.; (C) Chemistry—W. A. Noyes, of Terre Haute, Ind.; (D) Mechanical Science and Engineering—Frank O. Marvin, of Lawrence, Kan.; (E) Geology and Geography—Benjamin K. Emerson, of Amherst; (F) Zoölogy—Theodore N. Gill, of Washington, D. C.; (G) Botany—N. L. Britton, of New York city; (H) Anthropology—Alice C. Fletcher, of Washington, D. C.; (I) Social Science—William R. Lazenby, of Columbus, Ohio.

Prof. F. W. Putnam remains Permanent Secretary. The following are the other officers: General Secretary, Charles R. Barnes, of Madison, Wis. Secretary of the Council, Asaph Hall, Jr., of Ann Arbor, Mich. Secretaries of the Sections: (A) Mathematics and Astronomy—Edwin B. Frost, of Hanover, N. H.; (B) Physics—Frank P. Whitman, of Cleveland, Ohio; (C) Chemistry—Frank P. Venable, of Chapel Hill, N. C.; (D) Mechanical Science and Engineering—John Galbraith, of Toronto, Canada; (E) Geology and Geography—A. C. Gill, of Ithaca, N. Y.; (F) Zoölogy—D. S. Kellicott, of Columbus, Ohio; (G) Botany—George F. Atkinson, of Ithaca, N. Y.; (H) Anthropology—John G. Bourke, United States Army; (I) Social Science—R. T. Colburn, of Elizabeth, N. J. Treasurer, R. S. Woodward, of New York, N. Y.

LITERARY NOTICES.

THE FEMALE OFFENDER. By Prof. CÆSAR LOMBROSO and WILLIAM FERRERO. The Criminology Series, edited by W. DOUGLAS MORRISON. New York: D. Appleton & Co. Pp. 313. Price, $1.50.

THE scientific study of anthropology, which has risen to prominence within the last few years, bids fair to yield knowledge of much practical value. The anthropologists of several countries, and especially those of Italy, have been investigating the criminal class—trying to see if criminals *are* a distinct class, and what peculiarities mark them off from moral persons. When a basis of exact knowledge concerning criminals has been obtained, it will doubtless be possible to construct upon it much better modes of dealing with them than are now in vogue. Some results of this investigation have been made known to a limited circle through contributions to scientific journals and occasional volumes, but now the quantity of information collected has seemed to warrant the publication of a series of books devoted to criminology. As editor of the series the publishers have secured W. Douglas Morrison, M. A., of her Majesty's Prison, Wandsworth, England, a devoted student of the subject, and one who has had exceptional opportunities for observation. It is fitting that the series should begin with a book by Prof. Lombroso, who has devoted a laborious life mainly to criminal anthropology, and is the recognized leader of the Italian school in this branch of science. Associated with him as joint author is one of his most rapidly rising juniors—William Ferrero. As a result of their investigations, the authors regard as a complete type of the criminal woman one wherein exist four or more of the characteristics of degeneration. The criminal type in the female sex is rare as compared with the male. The reason is that women are generally occasional rather than habitual offenders. When a born offender, a woman is, in the majority of cases, an adulteress, a calumniator, a swindler, or a mere accomplice—offenses which require an attractive or at least a normal personal appearance. Atavism is regarded by our authors as the key to female delinquency. "The primitive woman was rarely a murderess, but she was always a prostitute"; hence the modern woman who degenerates atavistically takes to prostitution rather than to crimes of violence. The authors have given much attention to anthropometry, and present in this volume a large number of measurements of the skull, bodies, and limbs of female delinquents, also studies of brains, tests of senses, etc. The subject of suicide and the influence of hysteria and epilepsy on crime are considered. Tattooing, which is so common among male criminals as to become a special characteristic, is extremely rare in female delinquents. The discussions of the several topics treated are illustrated and fortified by many histories drawn from criminal records, and by portraits of French, German, and Russian subjects. The work is a valuable contribution to a new and much needed science.

MENTAL DEVELOPMENT IN THE CHILD AND THE RACE. METHODS AND PROCESSES. By JAMES MARK BALDWIN, M. A., Ph. D., Stuart Professor of Psychology in Princeton University. New York and London: Macmillan & Co. Pp. 496. Price, $2.60.

IN this work Prof. Baldwin appears as an observer, experimenter, theorizer, and critic, in short, as a maker of science, in which rôle he is quite as interesting and instructive as in that of expositor. The first event which led to the publication of this book was the birth of a daughter in 1890, whose mental unfolding was watched with unfailing attention. When she reached her ninth month he undertook to experiment with her to find out the exact state of her color perception. The account of his procedure, of the results reached, and his criticisms thereon, is given in Chapter III, entitled Distance and Color Perception by Infants. Chapter IV, on The Origin of Right-Handedness, describes the experiments undertaken to gain light upon the facts and conditions of left-handedness that had not before been closely observed. After discussing in the earlier chapters the general condition of the responsive movements of infancy and pointing out special problems, he enters in Chapter V upon a description of experiments concerning the rise of more complex movements. In 1892, at the birth of a second daughter, he continued his observations and planned new experiments, enlarging the scope of his

inquiries, and testing with her the inferences drawn from his experience with his first-born. There were two other infants under his observation at the time, though not so constantly and uninterruptedly as were his own children. In pursuing these studies Prof. Baldwin was led on to an enlargement of view concerning the mode and order of unfolding of mind in infancy, and the genesis of mind itself, and it is to this enlargement of view that we are indebted for the present work. It was while studying the child's imitations and their relation to volition that there came to him such a revelation concerning the function of imitation in the evolution of mind that he resolved to work out a theory of mental development embodying this new insight; and he soon saw that no consistent view of mental development in the individual could be reached without a doctrine of the race development of consciousness. With this conviction he undertook to make a synthesis of the biological theory of organic adaptation with the conception of infant development he had already reached. The work, he says, is a treatise upon this problem—an attempt to form a system of "genetic psychology." We can not give a fair account of Prof. Baldwin's theory in the limits of a book notice. But we will say, briefly, that he bases it upon the law of dynamogenesis, "which current psychology and biology agree in accepting as a well-established principle of the manifestations of organic and mental life. The principle of contractility, recognized in biology, simply states that all stimulations to living matter—from protoplasm to the highest vegetable and animal structures—if they take effect at all, tend to bring about movements or contractions in the mass of the organism. It is now also safely established as a phenomenon of consciousness that every sensation or incoming process tends to bring about action or outgoing process." It should be remarked here that the rise of hypnotism in late years has opened the way to an entirely new method of mental study. And it is now understood that "suggestion by idea, or through consciousness, must be recognized to be as fundamental a kind of motor stimulus as the direct excitation of a sense organ." Some idea of the importance of suggestion in modern psychology may be gained by noting the headings Prof. Baldwin has given to the sections in the long chapter upon this subject. They are (1) General Definition; (2) Physiological Suggestion; (3) Sensori-motor Suggestion; (4) Ideo-motor Suggestion;* (5) Subconscious Adult Suggestion; (6) Inhibitory Suggestion; (7) Hypnotic Suggestion; (8) Law of Dynamogenesis.

In attempting to reach some kind of formula of dynamogenesis, Prof. Baldwin found the definitions of "suggestion" in the psychologies very conflicting, and he therefore adopted the most general description of suggestive reaction—i. e., "that it always issues in a movement more or less closely associated in earlier experience with the particular stimulus in question." This definition constitutes suggestion a phenomenon of *habit;* but many suggestions issue in movements not exactly like those before associated with these stimuli. Many of them beget new movements, by a kind of adaptation of the organism, which are an improvement upon those the organism has formerly accomplished. This kind of adaptation Prof. Baldwin names *Accommodation*, and one of the main subjects discussed in the book is this theory of accommodation. The chapter upon suggestion closes with these words: "So far as we have gone we have a right to use the principle of suggestion as a principle of dynamogenesis whenever we mean to say simply that action follows stimulus. But when we come to ask what kind of action follows in each case each special kind of stimulus, we have two possibilities before us. A *habit* may follow or an *accommodation* may follow. Which is it? And why is it one rather than the other? These are the questions of the theory of organic development to which our next chapters are devoted." These nine chapters are upon The Theory of Development; The Origin of Motor Attitudes and Expressions; Organic Imitation; Conscious Imitation (begun); The Origin of Memory and Association; Conscious Imitation (continued); The Origin of Thought and Emotion; Conscious Imitation (concluded);

* Prof. Baldwin observed his children during their first two years to discover, if possible, whether ideo-motor suggestion is a normal thing, and the section upon this subject has absorbing interest.

The Origin of Volition; The Mechanism of Revival—Internal Speech and Song; Origin of Attention; Summary: Final Statement of Habit and Accommodation. These titles, as well as those given above of the sections of an earlier chapter, are very attractive, and we assure our readers that the text well sustains the interest excited by the headings, while the liveliness and earnestness of the style will be found pleasant accompaniments of the author's command of his subject. Of the scope and importance of this study Prof. Baldwin well says: "The study of children is generally the only means of testing our mental analysis. If we decide that a certain complex product is due to a union of simpler mental elements, then we may appeal to the proper period of child life to see the union taking place. The range of growth is so enormous from the infant to the adult, and the beginnings of the child's mental life are so low in the scale in the matter of instinctive and mental endowment, that there is hardly a question of analysis now under debate which may not be tested by this method." To the questions, what constitutes child study, and why we have so little of it, he replies that only the scientific specialist by the acutest exercise of his discriminative faculty can observe children or experiment upon them with profit. "Back of the question, What did the infant do? is the more difficult question, What did his doing that mean? And how can people who know nothing of the distinction between reflex and voluntary action, or between nervous adaptation and conscious selection, analyze the child's actions and arrive at a true picture of the mental condition that lies back of them? Even Preyer's experiments to determine the order of rise of the child's perceptions of different qualities of color, depending as they did upon word memories, are vitiated by the single fact that speech is acquired long after objects and some colors are distinguished." And if Preyer can thus misinterpret appearances, Prof. Baldwin may well say, "No child's deeds should be given universal value without a critical examination, before which even the most competent psychologist might well quail."

But notwithstanding these warnings, there is a brief popular section written in a somewhat homiletic strain in the chapter on conscious imitation, entitled How to Observe Children's Imitations. He begins with the statement that "nothing less than the child's personality is at stake in the method and matter of its imitation." The observer is told at length that he must take account of the personal influences which have affected the child; its relations to brothers and sisters and to other children, its chums and friendships in the school and home, and especially its games. The section closes with these words: "Finally, I may be allowed a word to interested parents. You can be of no use whatever to psychologists—to say nothing of the actual damage you may be to the children—*unless you know your babies through and through*. Especially the fathers! They are willing to study everything else. They know every corner of the house familiarly except the nursery. A man labors for his children ten hours a day, gets his life insured for their support after his death, and yet he lets their mental growth, the formation of their characters, the evolution of their personality, go on by absorption—if no worse—from common, vulgar, imported, and changing, often immoral, attendants! Plato said the state should train the children, and added that the wisest man should rule the state. . . . We hear a certain group of studies called the *humanities*, and it is right. But the best school in the *humanities* for every man is his own house." We have been much impressed by another strain of remark in the same section upon an only child. We have had for some time under our sympathetic observation a little boy whose brothers and sisters are grown, and the truth of the following statement is forcibly brought home to us: "An only child has only adult 'copy.' He can not interpret his father's actions, or his mother's oftentimes. He imitates very blindly. He lacks the more childish example of a brother or sister near himself in age. And this difference is of very great importance to his development. He lacks the stimulus, for example, of games in which personification is a direct tutor to selfhood. And while he becomes precocious in some lines of instruction, he fails in imagination, in brilliancy of fancy. The dramatic in his sense of social situations is largely hidden. It is a very great mistake to isolate children."

We close our notice with the sense that we have done this thoughtful book but scant justice.

PROCEEDINGS COMMEMORATIVE OF THE ONE HUNDRED AND FIFTIETH ANNIVERSARY OF THE FOUNDATION OF THE AMERICAN PHILOSOPHICAL SOCIETY. Philadelphia: MacCalla & Co. Pp. 647.

AN impressive commemoration of the origin of this pioneer scientific society was held in May, 1893. The exercises of the occasion, which extended over five days, are recorded in this handsomely printed volume, and include addresses of welcome and congratulation, the proceedings of the meetings, scientific papers presented, etc. The address by the venerable Frederick Fraley, president of the society, is followed by letters of greeting in French, German, and Latin, read by representatives of universities and foreign scientific societies, after which come telegrams from foreign bodies that were unable to send delegates. The second day's proceedings were also opened by an address by President Fraley, who was followed by Profs. Alpheus Hyatt and Hubert A. Newton. On the third day, President Gilman, of Johns Hopkins, and the Rt. Rev. John J. Keane, President of the Catholic University of America, delivered addresses, that of the latter only being printed. The exercises of the fourth day are especially interesting. They include addresses on Benjamin Franklin—printer, patriot, and philosopher, by Dr. Samuel A. Green; The Philosophy of Art, by Prof. J. M. Hoppin; and The Nature and Design of the Historical Societies of Our Country, by Dr. John B. Morris. On the last day a paper in German, On Determination of Gravity by Means of a Pendulum Apparatus, by R. von Sterneck, was read by Chevalier Rousseau d'Happoncourt, of the Austrian navy, who represented the Imperial Royal Academy of Vienna. Dr. Isaac Roberts then addressed the society on Recent Progress in Astronomical Science, illustrating his remarks by photographs which he presented to the society in behalf of the Royal Astronomical Society of England, which he represented. Prof. George F. Barker read a paper on Electrical Progress since 1743, dealing mainly with the work of Franklin, Hare, Henry, Saxton, Rittenhouse, and Bache. A few remarks on Magnetism, by Mr. Wharton, were followed by the closing address of the president. The scientific papers presented include one of eighty pages on Tertiary Tipulidæ, by Prof. Samuel H. Scudder; one of three hundred pages on Phylogeny of an Acquired Characteristic, by Prof. Alpheus Hyatt, and ten briefer ones by various authors. The volume is illustrated by a number of fine plates, including portraits of the officers of the society, views of the interior of its building, reproductions of the photographs presented by the Royal Astronomical Society, and figures illustrating the papers by Scudder, Packard, and Hyatt.

THEORETICAL CHEMISTRY, FROM THE STANDPOINT OF AVOGADRO'S RULE AND THERMODYNAMICS. By Prof. WALTER NERNST, Ph. D. Translated by Prof. CHARLES SKEELE PALMER, Ph. D. London and New York: Macmillan & Co. Pp. 697. Price, $5.

A FEW years ago it was said with truth that all the advances being made in chemistry were in the field of organic chemistry. This condition has been changed, however, by the fruitful researches of Ostwald, van't Hoff, Thomsen, Berthelot, and others, which have given us what may be called the new physical chemistry. Prof. Nernst has prepared a guide to this newly developed branch of the science, taking as its leading principles Avogadro's law and the doctrine of energy. Taking up first the universal properties of matter, he sets forth in succession those characteristic of the gaseous, liquid, and solid states of aggregation. The properties of physical mixtures and dilute solutions are also discussed. The theory of the atom and the molecule forms the second division of the work, this doctrine being tested and exemplified by the phenomena of refraction, polarization, magnetism, color, dissociation of gases, and the behavior of both colloids and crystalloids in solution. The transformation of matter and the transformation of energy are the two remaining divisions, the former embracing the laws of chemical statics and chemical kinetics, while the latter is concerned mainly with thermo-chemistry, though touching upon the chemical action of light and electricity. Two appendixes are added, the first comprising some important developments in theoretical and phys-

ical chemistry since the German edition of this work appeared, and the second being a valuable synchronistic table of chemical periodicals. The index is divided in the clumsy German fashion.

THE DYNAMO: ITS THEORY, DESIGN, AND MANUFACTURE. By C. C. HAWKINS and F. WALLIS. New York: Macmillan & Co. Pp. 520.

NOTHING need be added to the title of this book to indicate its field, and the authors claim no originality in the matter presented, except as to the construction of the equations for magnetic leakage, for the heating of dynamos, or the E. M. F. of alternators. "Yet we do claim," they say, "a certain novelty in our method of treatment by which these facts are presented. It has seemed to us that a systematic and methodical analysis of dynamos—of the causes and reasons why they have assumed their present shape—if only it be complete and accurate, so far as its scope extends, would still be sufficiently novel to merit attention. Starting with a simple inductor cutting the lines of a magnetic field, such an analysis would gradually evolve in natural sequence the various combinations of inductors which constitute the windings of armatures and the typical forms which the complete machine is thence compelled to take, until, finally, the whole should culminate in the description of actual machines as manufactured, and the practical design of one or more dynamos for given outputs. This scheme we have endeavored to carry out." The authors have taken pains to unite practice and theory in this treatise and to avoid mathematics and technicalities that were avoidable. There are one hundred and ninety illustrations, including cuts of a number of typical dynamos.

DESCRIPTIVE INORGANIC GENERAL CHEMISTRY. By PAUL C. FREER, Ph. D. (Munich). Boston: Allyn & Bacon. Pp. 550.

THIS book has been written for college students, and assumes some elementary knowledge of chemistry in those who are to use it. The author first gives a short chapter to the atomic theory, which he holds should not be presented in an elementary course, and then proceeds to describe the elements and their inorganic compounds. Oxygen is the first element described, hydrogen, the halogens, and the oxygen family following in succession. "In discussing chemical changes," Prof. Freer says, he has "endeavored to present the various topics, not as a series of isolated facts, but as so connected, the one with the other, that there is scarcely any one of the numerous phenomena which are mentioned in this work which does not find its analogon in some other portion of the field of chemical study. The attempt has been made especially to call attention to the influence exerted by the nature of the elements which make up a chemical compound upon the character of that compound itself." In his treatment of the latter subject he is aware that he may have been led into some speculation, but bespeaks at least a hearing for the new arguments he has ventured upon. His views on valence and the use of structural formulæ are conservative. In the application of physical methods in the study of chemistry he has followed Ostwald and Lothar Meyer, and in regard to the double halides, fluosilicic acid, and similarly constituted bodies he has adopted the views advocated by Prof. Remsen. There is an appendix of some forty pages of laboratory notes, which is "not intended as a laboratory manual, but mainly as a guide to both teacher and pupil in compiling a list of experiments."

CHURCHES AND CASTLES OF MEDIÆVAL FRANCE. By WALTER CRANSTON LARNED. New York: Charles Scribner's Sons. Pp. 236, with Plates. Price, $1.50.

THIS book, the author says, is a record of a traveler's impressions of the great monuments of France, published in the hope that it may bring others to visit them. "It is easy for the student to get accurate information about them; but nevertheless it may be of some use to tell what effect they produce upon one who does not wish to study deeply into all their history and the minute details of the building of them, but who does love their beauty and cares about the place they hold in the history of the French people." We read the systematic accounts of these things and get vague ideas about them as something shadowy and far distant; then, as a lady remarked on seeing the antiquities pre-

served in Winchester Castle and Cathedral, we go and look at them and find that they are all real. Next to seeing them for ourselves is reading the mind-pictures of them of one who has seen them intelligently, and of the emotional effects they have wrought upon him—with the guide-book information left out. A historical monument in France is defined by the author as meaning "a church, or a castle, or a town that has been thought worthy either of restoration or preservation at the expense of the French people. There is a tax levied to provide the money necessary for these purposes, and it is astonishing how much the French are willing to pay to preserve or restore whatever has to do with their history as a nation." More than thirty works, cathedrals, churches, castles, etc., of historical or architectural interest, are described in this book in the manner we have indicated.

THE ANIMAL AS A MACHINE AND PRIME MOTOR. By R. H. THURSTON. New York: John Wiley & Sons. Pp. 97. Price, $1.

THIS is a comparison of the animal as a piece of mechanism for the conversion, application, and utilization of energy with the various machines which man has constructed for the same purpose. The introductory chapter is a discourse on some of the more important physical laws and the efficiency of the most economical machines whose construction is based upon them. In the next chapter, The Animal as a Prime Motor, the various vital processes, the efficiency of vital machines, intensity of muscular effort, and the uses of food are among the most important headings. The third and concluding chapter considers some of the unsolved problems of the animal machine, such as the source of the firefly's glow and the animalcule's phosphorescence.

THE LAND BIRDS AND GAME BIRDS OF NEW ENGLAND. By H. D. MINOT. Second edition, edited by WILLIAM BREWSTER. Boston: Houghton, Mifflin & Co. Pp. 492. Price, $3.

IT has been often remarked that a teacher who is only a few lessons ahead of his class has an important advantage in that he can better appreciate the difficulties of his pupils than one who is further removed in attainments. On this account, as well as for his happy manner of imparting knowledge, Mr. Minot should be ranked as one of the most acceptable guides to the amateur ornithologist. His book is a remarkable production for a youth of seventeen. It gave substantial promise of important scientific and literary work which was left unfulfilled by the ill health that turned the author aside to a different profession and by his untimely death in a railroad collision. The book contains errors, and its statements as to range are deficient, but the editor has set sufficient danger signals against the former, and has duly supplemented the latter. It is not complete, but this does not prevent its being highly useful. Its descriptions comprise the external appearance of the species, its habits, range, appearance of its nest and eggs, and its song. An introduction contains directions for collecting birds and eggs, and for studying the birds at liberty. The illustrations are some twenty-odd outline drawings by the author and a frontispiece portrait.

A Tabular Review of Organography has been prepared by Prof. *A. L. Benedict* for the use of the classes in botany of the Department of Pharmacy in the University of Buffalo. In it each point has, so far as possible, been exemplified by some common plant; and each page of the manual is provided with a blank side to be filled in by the student himself. It is thus intended to adapt the little work especially for use as a guide in field study. An apology for hasty preparation at a season when the notes could not be verified by reference to wild plants is hardly in place in a scientific manual. With another summer affording the means desired, there should be no occasion for it to remain in another edition.

The papers of *Charles Robertson*, of Carlinville, Ill., upon the *Mutual Biological Relations of the Entomophilous Flora and the Anthophilous Insect Fauna* of his county of Macoupin are valuable to botanists and entomologists, and to all persons interested in horticulture.

In a little book on *Condiments, Spices, and Flavors*, a brief account is given by Dr. *Mary E. Green* of the substances classed under those heads, in the hope that it may lead to a more intelligent use of them in

cookery. In it are included the flavoring herbs known in our gardens; spices, etc., from abroad; condiments prepared from animal foods, mixed sauces like the Worcestershire, and ketchups and pickles. The author believes that these things, properly used, are aids to digestion. (Published by the Hotel World, Chicago.)

Of the *Eighteenth Annual Report of the Connecticut Agricultural Experiment Station*, for 1894, Part II contains papers on the availability of organic nitrogen, fungous diseases and their treatment, and injurious insects; Part III, Studies on the Proteids of Rye and Barley and on the Chemical Nature of Diastase; and Part IV on subjects relating to the dairy and on tobacco. The publications of the station are sent free to every citizen of the State who applies for them.

Under the title *Bread from Stones* a translation of some of the writings of Julius Hensel on fertilizers has been published by A. J. Tafel (1011 Arch Street, Philadelphia, 25 cents). Hensel declares that the current theory of fertilizing is wrong. Too much potash, phosphorus, and nitrogen, he says, are supplied to plants, and not enough lime, magnesia, silica, sulphur, or fluorine. The normal soil consists of weathered rocks. This is the best soil for plants, producing not only vigorous growth, but also edible parts of firm texture, resisting insects, and valuable and wholesome for food. He therefore advocates the use of finely pulverized stone-meal as a fertilizer, and gives testimony as to its efficiency.

The Senile Heart, by *George William Balfour*, M. D. (Macmillan, $1.50), is quite a comprehensive consideration of this and allied conditions in the other organs of the body to which the aged are especially prone. In the introductory chapter some space is given to a consideration of why we get old and why we so rarely die of old age, and this is followed in Chapter II by an examination of the direct effects of age on the heart muscle. There are twelve chapters, the last four of which deal with therapeutics. A chapter is given to gout, and also one to angina pectoris. The book contains some interesting sphygmographic records.

The consolidated school law of 1894 made a number of important changes; but as published it is a pamphlet of one hundred and thirty-five pages, the legal phraseology and verbiage of which obscures the meaning in many places. A *Handbook for School Trustees* (Bardeen, 50 cents), by *C. W. Bardeen*, which arranges the law by subjects and gives the minor details only in notes, ought to prove valuable to teachers and other school officers. The differences in law between the district and union schools are pointed out, and directions are given for the establishment of an academic department under the Regents of the University.

In a little volume, half prose half poetry, entitled *The Supremacy of the Spiritual* (Arena Publishing Company, 75 cents), Edward Randall Knowles, LL. D., undertakes to show that the ether is spiritual rather than material.

John A. Kersey has written down under the title *Ethics of Literature* a part of what he would like to say about books and authors—a part only, for on page 570 he states that he is about to close without having finished (the author, Marion, Ind.). "I propose to inquire," he says in his preface, "what some great literary luminaries have done, and to show in some instances what were better left undone for the enlightenment of mankind. And in this retrospect we will observe the acknowledged Titans engaged in Herculean labors to establish truths which, in the nature of things and of *mind*, are either self-evident or unprovable. We will observe minds which have given the world some of the most superb thought, grouping the rarest gems in clusters with the veriest *peter-funk*." Other instructive observations are also promised to the reader.

A neat little forty-cent edition of *Defoe's History of the Plague in London* is just issued by the American Book Company. While there is much fiction mixed up with the description, Defoe being only four years old at the time of the plague, there is enough of actual fact to give the work a historical value, and the less well authenticated portions add much to its readableness.

Roman Life in Latin Prose and Verse is the title of a book of selections from Latin writings, made by *Harry Thurston Peck* and *Robert Arrowsmith* (American Book Company). It is intended to be used either as the chief book for a short course in reading Latin or as a volume for sight-reading, and

may also serve as a series of specimens of Latin literature from the early popular songs down to the hymns of Christian Rome. The selections have been made with a view to exhibiting the life, manners, opinions, amusements, and dissipations of the Romans. The more difficult words are translated at the bottom of the page, and there are notes at the end on matters of allusion, style, and construction. The volume is illustrated.

In the *Orations on Bunker Hill Monument, the Character of Washington, and the Landing at Plymouth* (American Book Company, 20 cents), we have the three best oratorical efforts of *Daniel Webster*. His simplicity of diction and perfect mastery of pure idiomatic English render them excellent models for the pupil who would perfect himself in the use of the English tongue.

PUBLICATIONS RECEIVED.

Agricultural Experiment Stations—Reports and Bulletins. Connecticut: The Elm-Leaf Beetle; The San José Scale. Pp. 16.—Cornell University: Cherries. By L. H. Bailey and O. H. Powell. Pp. 32.—Massachusetts (Hatch Experiment Station): Commercial Fertilizers. Pp. 8.—Michigan: Crimson Clover, etc. Pp. 40; Fertilizer Analysis. Pp. 16.—Nebraska: Annual Report of the Botanist. By Charles E. Bessey. Pp. 24.—New Jersey: Report of the Botanical Department. By Byron D. Halsted. Pp. 140.—New York: Feeding Laying Hens. Pp. 18.—The Lutovka Cherry. P. 1.—North Dakota: Second Annual Report of the Weather Service. Pp. 28.—Weather and Crop Service, June and July. Pp. 16 each.—Ohio: Noxious Weeds along Thoroughfares and their Destruction. Pp. 8.—Purdue University: Commercial Fertilizers. Pp. 8, with Chart.

American Journal, The, of Sociology. Albin W. Small, Editor. Vol. I, No. 1. July, 1895. Chicago: University of Chicago Press. Pp. 112. 15 cents. $3 a year.

Ashley, Charles S. The Financial Question. Toledo, Ohio. Pp. 103.

Astronomical Society of the Pacific. Publications. Vol. VII, No. 43. Pp. 20, with several Plates.

Bay, J. Christian. Investigations concerning the Ætiology of Smallpox. Pp. 10.

Beal, F. E. L. Preliminary Report on the Food of Woodpeckers; and the Tongues of Woodpeckers. By F. A. Lucas. U. S. Department of Agriculture. Pp. 40, with Plates.

Carus, Paul. The Gospel of Buddha, according to Old Records. Chicago: Open Court Publishing Company. Pp. 275. $1.

Clare, L. Pierce, M. D., Middletown, Conn. Some Observations on an Epidemic of Typhus Fever. Pp. 27.—The Flechsig Method in the Treatment of Insane Epileptics. Pp. 24.

Committee of the Royal Medical and Chirurgical Society of London. Report on the Climates and Baths of Great Britain. Vol. I. Macmillan & Co. Pp. 640. $6.50.

Crosby, W. O. Tables for the Determination of Common Minerals. Boston: The Author. Pp. 106.

Daniell, Alfred. A Text-book of the Principles of Physics. Third edition. Macmillan & Co. Pp. 783. $4.

Donaldson, Henry Herbert. The Growth of the Brain. London: Walter Scott. Pp. 374.

Doyle, A. Conan. The Stark Munro Letters. New York: D. Appleton & Co. Pp. 285.

Eliot, Henrietta R., and Blow, Susan E. The Mottoes and Commentaries of Friedrich Froebel's Mother Play. New York: D. Appleton & Co. Pp. 310.

Frei, G. D., Editor. The Public Schools. Vol. I, No. 5. Clarksville, Tenn.: W. P. Titus. Pp. 16. 5 cents.

Green, Mason E. Are we losing the West? Boston: Charles E. Brown & Co. Pp. 31. 10 cents.

Harrop, H. B., and Wallis, Louis A. The Forces of Nature. Columbus, Ohio: Harrop & Wallis. Pp. 159. $1.25.

Holbrook, Dr. M. L. Hæmatoblasts and Blood Platelets. Pp. 10.

Hussey, W. J. A Study of the Physical Characteristics of Comet Rordame. Pp. 24.

Iowa Health Bulletin. J. F. Kennedy, Editor. August, 1895. Des Moines. Pp. 16.

James, Joseph F. Washington, D. C.: Fossil Fungi. Pp. 5.—Remarks on the Genus Anthrophycus, Hall. Pp. 5.—Daimonelix, or "Devil's Corkscrew," and Other Fossils. Pp. 10.—The St. Peter's Sandstone. Pp. 20.—The Genus Fucoides. Pp. 20. All with Plates.

Jarvis, Josephine, Translator. Friedrich Froebel's Pedagogics of the Kindergarten. New York: D. Appleton & Co. Pp. 337, with Plates.

Mace, William H. A Working Manual of American History for Teachers and Students. Syracuse, N. Y.: C. W. Bardeen. Pp. 297.

Michigan Mining School, Houghton. Prospectus of Elective Studies. Pp. 50.

Morgan, Thomas J. Patriotic Citizenship. American Book Company. Pp. 367. $1.

Old South Leaflets. The English Bible. (Extracts from Different Versions.) Pp. 20.

Polytechnic Institute of Brooklyn. The Course in Practical Chemistry. Prospectus. Pp. 24.

Quinn, Rev. D. A., Providence, R. I. Stenotypy, or Shorthand for the Typewriter. Second improved edition. Pp. 55.

Revue Franco-Americain. New York: E. T. Gurchy, 68 Fifth Avenue. Pp. 128. $1 a copy; $10 a year.

Roark, Runic N. Psychology in Education. American Book Company. Pp. 312. $1.

Scientific Alliance of New York. Fifth Annual Directory. Pp. 54. 25 cents.

Singleton, M. T. Gravitation and Cosmological Law. Atlanta, Ga. Pp. 23.

Starr, Frederick. Summary of the Archæology of Iowa. Pp. 134.—Comparative Religion Notes. Pp. 53.

Syms, L. C. First Year in French. American Book Company. Pp. 128. 50 cents.

Thompson, W. Gilman. Practical Dietetics, with Special Reference to Diet in Disease. New York: D. Appleton & Co. Pp. 802.

Tennessee State Board of Health Bulletin. Nashville, August 20, 1895. Pp. 16.

Udden, Prof. J. A. A Geological Section across the Northern Part of Illinois. Pp. 32.

United States Coast and Geodetic Survey. Notice to Mariners. (Chart Corrections.) Pp. 8.

United States Geological Survey. Fourteenth Annual Report of the Director, J. W. Powell. Part I. Pp. 321; Part II. Accompanying Papers. Pp. 597, with Maps.—Mineral Products of the United States. Chart.

Ward, Lester F. The Nomenclature Question. Pp. 20.

Watkins, James L. Production and Price of Cotton for One Hundred Years. U. S. Department of Agriculture. Pp. 20.

White, Frances Emily. The American Medical Woman. Pp. 16.

White, Francis A. Outline Studies in the History of the United States. American Book Company. 30 cents.

Willis, Bailey. The Northern Appalachians. American Book Company. Pp. 32. 20 cents.

POPULAR MISCELLANY.

An Instance of Webbed Fingers in Man.—(Communicated by F. E. LLOYD and F. L. WASHBURN.) The subject of this sketch, now about twenty-five years of age, was born near Smyrna, Iowa. He now resides in eastern Oregon, and is attending one of the State schools, where, though slow, he is proving himself fairly efficient in some lines of work.

Of large, powerful frame, he is a welcome adjunct on the football field, though ordinarily awkward in his movements. According to his statement, he has never suffered any special inconvenience from the abnormal condition of his hands, and feels disinclined to undergo a surgical operation for their betterment. When but a few days old, the webs were cut, but the operation was badly performed, and apparently their growth was not checked. The scars resulting from the operation may yet be seen. An interesting fact to be noted is, that the fourth finger and little finger of each hand are provided with only two movable joints or phalanges. On the fourth finger we find an enlargement at the point where the lower or distal end of the first joint should be. This rigidity, therefore, seems to have been brought about by a growing together or anchylosis of the first and second joints. The first joint or first phalanx of the little finger, however, although equal in length to two normal joints, is perfectly smooth and cylindrical. As if to compensate for this stiffness, the terminal joints of these two fingers can be bent to make a perfect right angle with the longitudinal axis of the finger. The toes are also webbed, but not so strikingly as the fingers. All of the following measurements have been made from a line passing through the distal end of the metacarpal bones; in other words, from the point where the bones of each finger unite with those of the hand. A centimetre is practically equivalent to two fifths of an inch.

To tip of second or index finger...	10·8 ctm.
" " third or middle finger...	12·4 ctm.
" " fourth finger.....	11·4 ctm.
To angle of web between second and third fingers.....	7·6 ctm.
To angle of web between third and fourth fingers.....	5·2 ctm.
To end of first joint of second index finger.....	5·7 ctm.

To end of first joint of third finger						7·3 ctm.
" " " " " little "						7·1 ctm.
" " " " " fourth "						6·4 ctm.
" " second " " " "						9·8 ctm.

The last two are the anchylosed phalanges mentioned above. The subject under discussion has one brother similarly affected, whose webs are decidedly larger than in the present instance. This brother has but one stiff joint on each hand. The father has hands somewhat webbed. A second brother has no webs, nor has the mother, nor the paternal or maternal grandparents.

How Stone Arrowheads were Made.—The guiding principle of Mr. F. H. Cushing's fruitful researches in anthropology has been "Put yourself in his place." When he wished to learn how stone arrowheads were made he became an arrow-maker himself. As a result of his labors and researches he was able to tell, in his address to the Anthropological Section of the American Association at Springfield, how primitive men made their arrows. They first sought the material, he said, mined it arduously from buried ledges, with fire, mauls, and skids, or preferably sought it in banks of pebbles, digging such as were fit freshly from the soil, if possible, and at once blocking out from them blanks for their blades by splitting the pebbles into suitable spalls. This was done by holding the pebbles edgewise on a hard base, and hitting them sharply and almost directly on the peripheries, but with a one-sided twist or turn of the maul or battering stone. At each deft stroke of the maul a spall was struck off—sometimes twenty from a single cobble or block of moderate size. These were, with almost incredible rapidity, trimmed to the leaf-shaped basis of all primitive chipped tools, by knapping them with a horn, bone, or very soft, tough, granular stone hammer, mounted in a light handle. For this the spall was placed flatwise on the knee, or on a padded hammer-stone, so called, and held down by the base of the thumb of one hand, and rapidly struck along the edge transversely and obliquely to its axis, lengthwise, with the outwardly twisting kind of blows used in the splitting. The blanks thus formed were then carried home for leisurely or opportune finishing; and carefully buried in damp soil, not to hide them, as has been usually supposed, but to keep them even-tempered, uniformly saturated or full of sap and life, as these ancients thought — whence the so-called "caches" of numerous leaf-shaped blades which are now and then found throughout old Indian ranges. To show that making arrowheads is not such a slow and laborious process as many have supposed Mr. Cushing stated that he had succeeded from the time he found a suitable pebble of fine-grained, ringing, cold and fresh quartzite, in making seven finished knife and arrow blades in exactly thirty-eight minutes; and he had often made from obsidian or glass a very small and delicate arrow point—the most easily made—in less than two minutes.

Chemistry advanced by the Industries.—In showing how pure science had been promoted by industrial operations and requirements, which was the theme of his vice-presidential address before the American Association, Mr. William McMurtrie cited an interesting example from Hoffmann, who says, "It is not generally known that the theory of substitution owes its source to a *soirée* in the Tuileries." Dumas had been called upon by his father-in-law, Alexandre Brongniart, who was director of the Sèvres porcelain works, and, as Hoffmann says, in a measure a member of the royal household, to examine into the cause of the irritating vapors from candles burned in the ballroom, a demand to which Dumas readily acceded, because he had already done some work upon the examination of wax which could not be bleached and was therefore unmerchantable. He was readily led to the conclusion that the candles used in the palace had been made with wax that had been bleached with chlorine, and that the vapors were hydrochloric acid generated in the burning of the candles. But examination of the wax of the candles showed that the quantity of chlorine found was greater than could be accounted by for its presence as a mechanical impurity, and from it Dumas was led to experiments which showed that many organic substances when heated with chlorine have the power to fix it, and from these results he was in turn led to the further generalization concerning the law of substitution. It was an incident similar to that

already described that brought Dumas to the reaction whereby hydrogen sulphide may be oxidized to sulphuric acid. He found the walls of one of the bath rooms at Aix-les-Bains covered with crystals of calcium sulphate, which could have no other source than the vapors liberated from the hot water.

Range of the Human Voice.—In discussing a paper read before the Section of Physics of the American Association, Prof. W. Le Conte Stevens remarked that the lowest recorded tone of the voice is that of a basso named Fischer, who lived during the sixteenth century, and who sounded F_0, about forty-three vibrations per second. Mr. Stevens himself, without possessing a bass voice, has sounded as low as A_0, fifty-three and a third vibrations per second, when his vocal cords were thickened by an attack of catarrh. This, however, is under abnormal conditions. The highest note hitherto recorded in the books was attained in singing by Lucrezia Ajugari. At Parma in 1770 she sang for Mozart several passages of extraordinarily high pitch, one of which included C_6, two thousand and forty-eight vibrations per second. She trilled in D_5, eleven hundred and fifty-two vibrations, and was able to sing as low as G_3, one hundred and ninety-two vibrations, having thus a range of nearly four octaves and a half. Ajugari's upper limit has been attained by Ellen Beach Yaw, of Rochester. Mr. Stevens has often estimated, by comparisons with a tuning fork, the pitch of a child's squeal while at play, which has been repeatedly found to be in excess of twenty-five hundred vibrations per second, in one case as high as G_6, about three thousand and seventy-two vibrations. The total range between these extremes is in excess of six octaves.

Criminal Anthropology.—Among reasons for including anthropology among the preparatory studies for medicine, Mr. Havelock Ellis refers to special branches of practice in which knowledge of it is of great assistance—such as practice abroad among different races, and practice among the insane at home, and in dealing with the phenomena of crime. Numbers of criminals inherit their qualities and transmit them, and constitute a distinct class. Their increase must be prevented by dispersing them and checking the reproduction of their kind. In the light of these principles, Lombroso has constructed his system of criminal anthropology. The Lancet says that in Paris medical experts are appointed to examine the persons arrested overnight, and to send to asylums those whom they find to be troubled with brain disease, whereby they are secured from association with criminals and soon may be restored to soundness. Dr. Benedikt, of Vienna, has done great service in this line of practice in his studies of criminals of different types. Three factors are named by Dr. Clouston which should be taken cognizance of in criminal anthropology, viz.: The heredity of the criminal; his brain, with its reactive and resisting qualities in each case; and the criminal's surroundings, immediate and permanent. The first takes account of the past history of the criminal's family, and the transmission of its inherited diseases into other diseases in offspring. The second factor, involving the receptivity and reactive power of the brain, its resources in self-control, especially in withstanding pain, fear, temptation, and other trials of the moral sense, concerns a wide field and presents great difficulties to the investigator. The third factor includes the mental and social atmosphere in which the subject of criminal anthropological inquiry has been brought up, and must comprise early companionship, moral and religious influence, and whatever contributes to motive in its less healthy tissues. "Those tracts of the brain cortex organized for mental processes are the field in which the future character of the individual—criminal or non-criminal—germinates and grows; they are, as Dr. Clouston well puts it, 'the fullest of hereditary qualities, the most powerful, yet the most notable, by far the most physiologically valuable part of man,' and the question that confronts the student of criminality he formulates thus: 'Have we among us men and women whose mental cortex is of such quality that in its ordinary environment the conduct of its possessors must necessarily be anti-social and lawless? and if so, what anatomical, physiological, and psychological signs are there to distinguish this criminal cortex and its possessor?'" The Italian

and some of the German school assert that such signs exist, and are not difficult to recognize; or, that the criminal was a criminal potentially before he was one actually. The chief problem of dealing with crime fundamentally is, then, one of taking it at this stage; and it is here that medical anthropology can make itself most useful.

Explorations in Labrador and Alaska.—Of the geographical explorations on the American continent during 1894, Prof. Angelo Heilprin, in the Bulletin of the Geographical Club of Philadelphia, mentions as most noteworthy those of Messrs. Tyrrell and Low, on British territory. To the former we owe the exploration of a large portion of unknown region lying to the west of Hudson Bay—a region that for at least six hundred miles was totally unknown—and the rectification of much of the western contour of the bay. A peculiarity of the region traveled over by Mr. Tyrrell is the total absence of timber. "All the wood that was gathered in the course of this six hundred miles' journey, it is said, would not have been sufficient to give the material for a single boot-peg. On the other hand, even in this most treeless area, game of at least one kind is described as being most unmanageably abundant. Over an area of three square miles or more the reindeer were so thick as almost completely to shut out from view the ground." To Mr. Low belongs the honor of having made the first crossing of Labrador. Beginning at Lake Mistassini on the east, and terminating at Ungava Bay on the north, he crossed the height of land of the region, a rugged and forbidding country, partly timber-covered, and in the main devoid of inhabitants. No specially marked physiographic features were discovered, no great mountain ridges or peaks, and no large streams, "but the accessions of general knowledge to a region are always welcome, and particularly when it is so little known as is Labrador." A third exploration on our continent is that of the joint Anglo-American Alaska Boundary Commission. The statements in the newspapers that the surveys of this commission would remove Mount St. Elias from the United States to British America is "perhaps premature," and Mr. J. C. Russell, who first definitely determined the position of the mountain, is quoted as authority for saying that no basis exists for the assumed necessary transfer. Two other peaks, however, possibly higher than Mount St. Elias, have been observed, unquestionably on British soil.

Snow-coloring Insects.—An interesting communication has been published from Dr. Vogler de Schaffhouse concerning red snow-insects. An excursion of a Vaudois society to the Great St. Bernard in August, 1893, at an altitude of twenty-six hundred metres, near the col de Fenêtre remarked in a little *combe* at the left of the path a well-defined rose-red spot on the snow. One of the excursionists, M. Théodore Bottinger, found by the aid of a glass that the red color was due to little jumping insects, of which thousands were distributed on the surface of the melting snow. There were such prodigious numbers of them at the bottom of the combe that they formed a compact mass an inch thick in spots, like a bed of orange-red sawdust. The insect, called in French a *podurelle*, is a new species of the *Lipura* of Burmeister—the *Anurophorus* of Nicolet, hitherto undescribed. The red and black colorations of snow are usually ascribed to an alga (*Protococcus nivalis*), which turns black from red in the course of its growth. M. J. Brun observes, in an article he has published on the subject of coloration, that he has met the podurelle of Benedict de Saussure (*Desoria glacialis*) in innumerable masses, and believes that the existence of the podurelle is connected with that of the protococcus, and that the insects owe their color to the black spores on which they feed. It appears, then, that the coloration of the snow is chiefly due to the presence of the lower vegetation, but that the existence of the podurelles being connected with that of the protococcus, those insects may under some circumstances contribute by their number to form colored spots.

Power of Petty Superstitions.—The force of superstition, the London Spectator observes, in an article on that subject, is rarely felt by the cultured Englishmen, because their superstitions are usually unimportant, it not signifying much whether you pass under a ladder or not, or whether you

are for a moment alarmed because you have broken a mirror; but among a great portion of mankind, including a section of the poor of enlightened countries, the smaller superstitions make up a real and heavy burden. They keep up a permanent distrust in the goodness of Providence, and a watchfulness to avoid evils from unknown forces which is most enfeebling. A French or Italian peasant will do nothing that is opposed to certain apothegms registered in his mind as dogmas, and an Asiatic peasant is bound hand and foot by a whole system of beliefs in omens which cramp his energies as much as even the rabbinical views of the law as to anise and cummin cramped the energies of the Jews in the time of Christ. There is not an Asiatic in the world who would dare go dead against the warnings of his horoscope, and very few Europeans of the Continent would stride forward resolutely in an undertaking the beginning of which has been marked by a stumble or a failure. Even in England this special idea about omens has amazing influence, as have also the other beliefs in premonition or presentiment. We all know the annoyance to which the belief in the superstition about thirteen subjects English dinner-goers, while on the Continent it is difficult, and in Paris impossible, to let a house with the number thirteen on the door. Even the iron logic of French functionaries gives way before that belief, and proprietors of rows are permitted to register the thirteenth house as 12 B.

Heavy Rainfall and Ship Canals.—The best series of rainfall observations in Central America, according to Prof. M. W. Harrington, is that taken at San José, Costa Rica, by Prof. Enrique Pettier. Several other series are nearly as good. The greatest hourly rainfall observed there was 1·9 inches, or at a rate of forty-six inches—or nearly four feet—per day. "The results of such enormous falls of rain have often been described and can easily be imagined. The dry stream beds or *quebradas*, very common on the plateaus, are rapidly filled; the water comes down in a wall several feet high; the camping place, two or six feet above the water, is overflowed, and soon the new camping place, hastily sought in the dark and several feet higher, is also overflowed. In such a country as Mosquitia dry stream beds become rivers, marshes change to lakes, and the natives temporarily take to the trees or to their boats. While all this is striking, it is by no means unparalleled in the temperate regions. . . . The difference between such falls of rain in the tropics and in the temperate zones is chiefly that in the latter they are occasional, while in the tropics they are customary. These conditions are especially interesting from the standpoint of the possible ship canals in Central America. . . . It must be acknowledged that the conditions at Suez, Sault St. Marie, and the Welland Canal are in this respect very favorable, for in them the question of sudden floods does not enter. It enters in the case of the great ship canal of St. Petersburg-Cronstadt and of those of the Ganges-Brahmaputra Delta; but in these cases there are no changes of level sufficient to make the use of locks necessary. Indeed, the use of locks on ship canals where feeders are subject to sudden and violent floods appears to present a new engineering problem, first met in the Panama Canal."

House and Room Ventilation.—Draughts in houses may be defined, Dr. G. V. Poore says, as currents of air rushing in at the many places through channels that have insufficient area. The only way to cure draughts is to place inlets of sufficient area in proper positions. When building a house, one might place louvre ventilators in the walls between room and passage at a height of six and a half feet above the floor. The alteration of a door panel into a ventilator costs only a trifle. In the author's experience it is a most excellent way of ventilating a room, always provided that the air of the passages be wholesome. Windows should extend to within a few inches of the ceiling, and should open at the top. If the room be twelve or thirteen feet high, and the windows go to the top, then the window becomes unmanageable from its height, and the opening at the top, though theoretically possible, is seldom put in practice. The wholesomeness of a room depends very much upon the rapidity with which the air within it can be renewed—the facility, in short, with which one can give it a blow-out. This depends upon the relation of window area to entire capacity. Windows should be so constructed that they can be easily ma-

nipulated by a child. The louvre window ventilator, such as is common in churches, will be found very valuable for the admission of a constant but comparatively small supply of air. Relatively low rooms, with big, mullioned windows going to within a few inches of the ceiling, are far more wholesome than lofty rooms in which the tops of the walls are inaccessible to the housemaid, and the window sashes are too weighty for her to move them without difficulty. For wholesomeness and comfort the author believes a height of ten feet is sufficient for any domestic living room and nine feet for a bedroom. Provided the windows go to the top and can be easily opened, it is very doubtful if there is any object, from the purely sanitary point of view, in having rooms more than nine feet high. Facility for cleaning should be ever in the mind of both builder and furnisher. The modern boudoir, hung with dabs of mediæval rags and stuffed with furniture and knickknacks, is often not very cleanly, and when the daylight is excluded, lest fading should take place, and the sun's rays never have a chance of disinfecting the dust on and behind the curios, it can not be very wholesome.

Tepee and Other Buttes.—The term butte is ordinarily applied to steep-sided hills with narrow summits. More rarely it has been employed to designate mountains, but this is probably obsolescent. The tepee buttes described by Messrs. G. K. Gilbert and F. P. Gulliver in their paper on that subject are so called on account of their resemblance to the lodges, or tepees, of the Sioux Indians. They are constituted around limestone masses in the Pierre shales of Colorado, higher than wide, and in all dimensions of a size to be measured by feet or yards, which, resisting erosion much better than the shales, stand above the general surface. Their fallen fragments protect sloping pedestals of shale, and their positions are marked in the landscape by conical knolls. These limestone masses may be called *tepee cores* and their material *tepee rock*. They are found scattered irregularly over a considerable district within the Pierre group, in places so thickly set that hundreds may be seen from one point, while elsewhere they are solitary or in groups of two or three. The tepee rock is of coarse texture, breaking with rough fracture, of light, warm gray color, and full of fossil marine shells (*Lucina*), imbedded in a matrix composed of fragments of shell, water-worn grains of calcite, foraminfera, and clay. Allied phenomena are found in Canada, of "great spongy and cavernous masses," forming islets which the Indians call wigwams and the caverns doors. Other forms of butte mentioned by the authors are the butte marking the site of a volcanic neck, which differs from the tepee butte in the nature of the core; the dike, or elongated butte, having a vertical plate rather than a cylinder for a core; the cylinder butte, which does not owe its form to a hard core, though it may have one, and when freshly formed has a crater at the top; the spring butte, formed by deposition from the water of geysers or other springs; and the *mesa* butte, which is the remnant of a tabular outlier, and is carved, like the tepee butte, from a greater mass, but has a hard cap instead of a hard core, and hence a flat-topped instead of a conical form.

Scientific Work of the Franklin Institute.—A historical sketch of the Franklin Institute, Philadelphia, compiled by Mr. Wahl, the secretary, contains a full and only just account of the work it has done during the seventy years of its existence for the advancement of science and the useful arts. Among the most prominent of the works in which it has been engaged, the first of general public importance was the investigation of the various forms of water wheels for giving economical value to water power. Following this, and in the same line of practical usefulness, was an investigation of the cause of the explosion of steam boilers. Closely connected with these experiments was an inquiry into the strength of materials used in construction. These investigations, the results of which were published in the Journal of the Institute, formed a contribution of great value to manufacturers of steam machinery, architects, and builders. At the instance of the Government, the Institute made an investigation and report on the suitability of various building stones, with special reference to the construction of the Delaware Breakwater. At the request of the Legislature of Pennsylvania it examined and report-

ed on our system of weights and measures, providing the basis of the present State law. In 1843 it secured an appropriation for the equipment of stations for the systematic observation and collection of meteorological facts—probably the earliest instance in this country of such an appropriation. This work was begun, extended, and carried on under the direction of the committee of the Institute for several years, and the collection of weather data by the observers it has enlisted was continued afterward. The Institute suggested, in 1887, the institution of the present State weather service. In 1864 it obtained a report on the shape and proportions of screw threads used in machine construction, which gave the basis for the standard now universally current in this country. It participated, through its committee, in 1875, in the inquiry concerning the present and future water supply of Philadelphia. Its investigation, in 1878, of the efficiency of the dynamo-electric machine for arc lighting appears to have been the earliest intelligent inquiry into the relative merits of the several types of these machines. In 1884 a more elaborate report was issued on the same subject, and another on the Life-Duration and Efficiency of Incandescent Electric Lamps. Allied to these investigations was its report on The Conditions of Safety in Electric Lighting, published in December, 1881, which formulated for the first time a number of the conditions to be observed in the wiring of buildings and the running of circuits, which have since become incorporated in the regulations of the Fire Underwriters' Association.

North Nyassa Superstitions.—Connected with the superstitions of the people of the region north of Lake Nyassa, in Africa, are the sacred groves or burial places of their ancestors. The undergrowth in them is so thick that the sun's rays seldom penetrate. In their days of trouble the priests resort there to pray to the spirits of their fathers. In them the prophets deliver their messages. No other living creature is allowed to enter. Should war or disease visit the tribe, the priest kills a bull, and offers the blood and the head of the animal. The people firmly believe in the spirit of evil. He is "Mbasi." In one place Mbasi is a person—an old man—who exercises extraordinary power. He speaks only at night, and to the head men of the tribe, and during the interview every other voice must be silent and every light extinguished. In Wundale the people believe in such a person, who has the power to make lions, and who employs them as messengers of evil. His house is surrounded with long grass, in which he keeps his lions, as other men keep dogs. If a man has a dispute with a neighbor who refuses to come to terms, these lions may be hired to destroy his cattle. Dr. D. Kerr-Cross was much struck to find that all over the north end of Lake Nyassa the people regularly perform a *post-mortem* to the dead. Death in war is the only exception. One of the elderly men takes a strip of bamboo, and, making an incision in the abdominal wall below the ribs, carefully inspects the viscera. They bury immediately outside the door of the house, and in a sitting posture. In Wundale, about a year after the decease, and at dead of night, the friends lift the bones and cast them into certain clumps of trees found all over the country. These groves are full of human bones.

The Vitality of Seeds.—Discussing the vitality of seeds, Mr. W. Botting Hemsley first speaks of the infinity of variety in the behavior of seeds under different conditions. Neither under natural nor under artificial conditions will some seeds retain their vitality more than one season. Others will hold their life for a time that has not yet been defined. The scarlet-runner bean loses its germinative power on exposure to comparatively slight frost, the degree depending upon the amount of moisture in it; yet it will retain its vitality for an almost indefinite period under favorable artificial conditions. In both this seed and the acorn germination would naturally follow as soon after maturation as the conditions allowed. The seeds of the hawthorn are incased in a hard, bony envelope, in addition to the proper coat or *testa*. Committed to the earth, and under the most favorable conditions, these seeds do not germinate till the second year, and often not so soon. Prolongation of vitality is probably due in some measure to the protective nature of the shell inclosing the seed. The primary condition to the preservation of vitality in a seed is perfect ripeness. Un-

ripe seeds of many kinds will germinate and grow into independent plants if sown immediately after removal from the parent. This may be readily observed in wheat, and the same property is found occasionally in various other plants. Sometimes the seeds of pulpy fruits germinate in the fruit. The vitality of certain seeds is not impaired by floating and being partially submerged in sea water for as long as a year. Plants are growing at Kew from seeds that have been thus exposed. Some seeds will bear immersion in boiling water for a short time; but seeds of all kinds will bear for a considerably longer period a much higher dry temperature than they will soaking in water of the same temperature. Dry grain is equally impervious to cold. Some of the fir trees, especially of North America, bear the seed vessels containing quick seeds of many successive seasons; and only under the influence of forest fires or excessive drought do they open and release the seed. The unopened cones of thirty years have been counted on some fir trees; and it is averred that the seed vessels of some proteaceous trees do not open to shed their seed, under ordinary conditions, until the death of the parent plants. The stories of the germination of "mummy wheat" have not been confirmed; but kidney beans taken from the herbarium of Tournefort are said to have grown after having been thus preserved for at least a hundred years. Wheat and rye are said to have preserved their vitality for as long a period. Seeds of the sensitive plant germinated at the Jardin des Plantes, Paris, when sixty years old. If seeds retain their vitality for so long periods under such conditions, it is quite conceivable that seeds buried deep in the earth, beyond atmospheric influences and where there is not excessive moisture, might retain their germinative power for an indefinite period.

Cultivation of Dates at Tafilet.—The cultivation of dates and leather work form, according to Mr. Walter B. Harris, the sole industries of Tafilet, Morocco. The water for irrigating purposes is brought by many canals from the Wad Biz to the palm groves. The soil under the trees is carefully dug, and divided by low raised banks into squares from ten to twenty yards in extent. Into these, by removing a small part of the bank into which the water flows—for the canals are raised above the general level of the soil—a connection is formed with the canal and the land flooded, the water being allowed to proceed from square to square by removing portions of the dikes. The object of this irrigating of the patches separately is to avoid waste, only the portion which actually requires water receiving it; these squares are cultivated with lucerne, wheat, and barley where the shade of the palms is not excessive, and maize and palms, the latter of which are not so common as in other parts of the desert, for the dates take their place as the staple article of food of the people. Besides the palm supplying the people with provision, the coarser species of dates are employed for fodder, and constitute the chief food of such cattle as there are, and of horses and donkeys. The finer qualities are exported to Fez and Morocco City by caravan, the pack animals bringing in return wheat and European manufactures and rough iron. About ninety per cent of the export of Tafilet dates from Morocco go to London.

NOTES.

In the construction of the new speedway at High Bridge, New York, a bed of quicksand was encountered, which much impeded the work. The difficulty was obviated by the artificial refrigerating process. A row of four-inch pipes was sunk a few feet apart to the depth of forty feet. These pipes were capped at the bottom, and inside them were inserted smaller pipes open at the bottom. Cold air was forced fom a condenser through the smaller pipes into the larger and thence returned to the condenser. The air was cooled by expansion to a temperature of about —45° C., thus freezing the surrounding mud and wet sand, and checking the flow into the excavation.

A Mr. Bickerton, of Liverpool, proposes to avoid the hardship of having—in the future—to remove from the marine service persons who may be found defective in vision by making the tests for their admission more stringent. He therefore suggests new rules providing that no boy or man shall be allowed to enter the service until his form vision and color vision have been tested and found sufficient; that their certificate of eyesight be exhibited by seamen before they are permitted to sign articles; that color-blindness and defective vision be made in themselves reasons for breaking indenture engage-

ments; that officers affected in their vision be given shore employment; and that certain specified improvements be introduced into the method of testing for defects of vision.

THE way changes are produced in the configuration of the country in a region of lakes by the action of the water is illustrated in a recent lecture by R. H. Mill. Taking certain English and Scotch lakes, Loch Tay has been gradually silted up during the last thirty years; a stony peninsula is building up at the foot of Ullswater; the rush of the waves is slowly eating away the eastern shore of Windermere; the affluent rivers are filling Haweswater with stones and rubbish, and a delta has been formed which nearly cuts the lake in two—a process which has been completed in certain lakes that are specified. The famous floating island of Derwentwater is probably a piece of the moat of waterweed that covers the floor of some parts of the lake, raised to the surface by the gas given off by its own decomposition.

THOREAU says in his Early Spring in Massachusetts, speaking of a class of books which have not yet gone out of fashion: "A good book is not made in the cheap and offhand manner of many of our scientific reports, ushered in by the message of the President communicating it to Congress, and the order of Congress that many thousand copies be printed with the letters of instruction from the Secretary of the Interior (or rather exterior), the bulk of the book being a journal of a picnic or sporting expedition by a brevet lieutenant-colonel, illustrated by photographs of the traveler's footsteps across the plains, and an admirable engraving of his native village as it appeared on his leaving it, and followed by an appendix on the paleontology of the route by a distinguished *savant* who was not there; the last illustrated by very finely executed engravings of some old broken shells picked up on the road."

OF a limited study of dietaries, mostly in New England, acknowledged to be imperfect, the results, as summarized by Prof. W. O. Atwater, decidedly confirm the general impression of hygienists that our diet is one-sided and that we eat too much. The food which we actually eat, leaving out of account that which we throw away, has relatively too little protein and too much fat, starch, and sugar. This is due partly to our large consumption of sugar and partly to our use of fat meats. The rejection of so much of the fat of meat at the market and on our plates at the table is not mere willfulness. It is in obedience to Nature's protest against a one-sided and excessive diet. How much harm is done to health by our one-sided and excessive diet no one can say. Physicians tell us that it is very great.

A SUCCESSFUL demonstration was given in April to a meeting of medical men in London by Mr. S. Schöntheil, of the most modern and scientific method of training the deaf and dumb so as to enable them to use articulate speech and give them a full command of language. Several pupils were introduced who were subjected, with highly satisfactory results, to exercises in pronunciation, lip-reading, dictation, recitation, reading, and answering miscellaneous questions.

IT is now generally recognized in Great Britain, ex-President Teall, of the Geological Section of the British Association, says, that there is no important difference in structure or composition between the rhyolites, andesites, and basalts of the Palæozoic and of the Tertiary periods. Identity of structure and composition in this case implies identity in the physical conditions under which the rocks were produced. Hence we may sum up the case of the bearing of volcanic rocks on the theory that, so long as observations are confined to a limited area, doubts may arise as to the truth of the uniformitarian view, but these doubts gradually fall away as the area of observations is extended. There are still some outstanding difficulties, but, as many similar ones have been overcome in the past, it is improbable that those that remain will prove formidable.

OBITUARY NOTES.

THE death of Prof. Valentine Ball, of Dublin, is a serious loss to the scientific circles of that town. He contributed much to the literature on precious stones, and published several books of travels. Although of fine physique, he died at the age of only fifty-one.

THE death is announced of Prof. Baillon, Director of the Botanical Laboratory of the faculty of medicine at the Sorbonne. He was one of the most distinguished of the French botanists and a very prolific writer. He was born at Calais, November 30, 1827.

DR. FRIEDRICH TIETJEN died on June 21, 1895. He was Professor of Astronomy at Berlin University and editor of the Astronomischen Jahrbuch. He was born in 1834. His most important labors lie in the region of astronomical computation.

DR. FRIEDRICH WILHELM GUSTAV SPÖRER, chief observer in the Astrophysical Observatory at Potsdam, died on the 7th of July of heart disease. He was born in Berlin, October 23, 1822. He took his degree from the Berlin University in 1843. He did a large amount of valuable astronomical work, being especially interested in sun spots, his work on these making his name known to the scientific world.

INDEX.

ARTICLES MARKED WITH AN ASTERISK ARE ILLUSTRATED.

PAGE

Abbott, Charles C. Timothy Abbott Conrad. (With Portrait)..... 257
Abrasive Substances. (Misc.)..... 426
American Association, Meeting of the. (Misc.)..... 421
" " The, at Springfield. (Editor's Table)..... 846
Ancestor-worship among the Fijians. B. H. Thomson..... 671
Animals and Plants, Distinction of. (Misc.)..... 286
" Variation in the Habits of. G. C. Davenport..... 619
Anthropology, The Growth of. (Editor's Table)..... 265
Antillean Continent, The Former. (Misc.)..... 425
" Elevations and Depressions. (Misc.)..... 570
Archæology in Denmark.* F. Starr..... 12
Argon: the New Constituent of the Air. J. T. Stoddard..... 522
" The New Element in the Atmosphere. (Misc.)..... 286
Armadillo, The, and its Oddities.* C. H. Coe..... 354
Art, Aboriginal, in Copper. (Misc.)..... 571
" and Eyesight.* L. Howe..... 458
Astronomical Work of Harvard Observatory. (Misc.)..... 285

Bactericidal Solar Rays. (Misc.)..... 281
Balfour's, Mr., Dialectics. H. Spencer..... 327
Bárbara, To. (With Portrait.) D. S. Jordan..... 538
Baskets, The, of Lichtenfels. (Misc.)..... 138
Beaulieu, Paul Leroy. The Office of Luxury..... 25
Benjafield, Harry. Fruit as a Food and Medicine..... 677
Bergen, Mrs. Fanny D. Survivals of Sun-worship..... 249
Biological Laboratory at Cold Spring. (Misc.)..... 139
Birds' Eggs, Coloration of. (Misc.)..... 710
Birds of Prey, Hunting with.* E. Blanc..... 818
" The Study of, Out-of-doors.* F. M. Chapman..... 664
Blanc, Edouard. Hunting with Birds of Prey *..... 818
Boerhaave, The Illustrious. (With Portrait.) W. T. Lusk..... 110
Bohn, Grace Green. Steel Engravings as Works of Art. (Corr.).... 121
Bond, William Cranch, Sketch of.* (With Portrait)..... 400
Books noticed..... 126, 268, 411, 559, 701, 848

Aërial Navigation, Proceedings of the International Conference on, 129.
Aëronautical Annual for 1895. James Means, *editor*, 414.
Alabama, Geological Survey of. A Report on the Geology of the Coastal Plain of Alabama, 564.
American Philosophical Society, Proceedings commemorative of the One Hundred and Fiftieth Anniversary of the Foundation of the, 851.
Angot, Alfred. Les Aurores Polaires, 419.
Anthony, Gardner C. Elements of Mechanical Drawing, 133.

Books noticed :

Arrowsmith, Robert, and George M. Whicher, *editors*. First Latin Readings, 416.
Art Education. Vol. I, No. 1, 134.
Astrophysical Journal. Vol. I, Nos. 1 and 2, 413.
Atken, Charles H. The Ills of the South, 130.
Baldwin, James Mark. Handbook of Psychology, 701.
— Mental Development in the Child and the Race, 848.
— Elements of Psychology, 701.
Balfour, George W. The Senile Heart, 854.
Bardeen, C. W. Handbook for School Trustees, 854.
— Roderick Hume; the Story of a New York Teacher, 417.
Barnett, Mrs. S. A. The Making of the Body, 268.
Bass, Florence. Animal Life, 418.
Benedict, A. L. A Tabular Review of Organography, 853.
Bhikshu, Subhadra. A Buddhist Catechism, 132.
Bigelow, Robert P. Report on the Crustacea of the Order Stomatopoda, 276.
Binet, Alfred. Psychologie des Grands Calculateurs et Joueurs d'Echecs, 130.
Bird, Charles. Geology, 706.
Boston Society of Natural History. Proceedings. Vol. XXVI, Parts II and III, 275.
Bottone, S. R. Electricity and Magnetism, 559.
Brunache, P. Le Centre de l'Afrique autour du Tchad, 419.
Call, Richard E. The Life and Writings of Rafinesque, 271.
Carhart, Henry S. Physics for University Students, 559.
Carus, Paul. The Gospel of Buddha, 132.
— The Nature of the State, 707.
Cary, George H. How to Make and Use the Telephone, 559.
Catholic University Bulletin, 415.
Chambers, George F. The Story of the Stars, 560.
Chapman, Frank M. Handbook of Birds of Eastern North America, 708.
Cicero, M. T. De Senectute, 565.
Clodd, Edward. The Story of "Primitive" Man, 705.
Cobbe, William Rosser. Dr. Judas : a Portrayal of the Opium Habit, 561.
Comstock, John Henry, and Anna Botsford. A Manual for the Study of Insects, 411.
Connecticut Agricultural Experiment Station. Eighteenth Annual Report, 854.
Connell, William C. The Currency and the Banking Laws of the Dominion of Canada, 133.
Curry, J. L. M. Education of the Negroes since 1860, 707.
Daily News Almanac and Political Register for 1895, 414.
Dana, James D. Manual of Geology, 413.
Davidson, Thomas. The Education of the Greek People, 411.
Davis, Walter G. Annales de la Oficine Meteorologica Argentina, 417.
Defoe, Daniel. History of the Plague in London, 854.
Dooner, P. W. The Genesis of Water, 134.
Farquhar, Henry. A Stable Money Standard, 134.
Ferree, Barr, and others. Architectural Education for America, 564.
Fewkes, J. Walter. The Walpi Flute Observance, 274.
Foster, Horatio A. Central Station Bookkeeping and Suggested Forms, 275.
Freer, Paul C. Descriptive Inorganic General Chemistry, 852.
Gay, Selina. The World's Great Farm, 274.
Geikie, Sir Archibald. Memoir of Sir Andrew Crombie Ramsay, 270.
Geikie, James. The Great Ice Age and its Relation to the Antiquity of Man, 126.
Gould, S. Baring-. Noémi, 565.
Gowers, W. R. The Dynamics of Life, 133.
Green, Mary E. Condiments, Spices, and Flavors, 853.
Griffing, Harold. On Sensations from Pressure and Impact, 564.
Griswold, W. M. Index to St. Nicholas, Vols. I to XXI, 275.
Harris, William T. How to Teach Natural Science, 415.
Hawkins, C. C., and F. Wallis. The Dynamo, 852.
Hensel, Julius. Bread from Stones, 854.
Herdler, Alexander W., *editor*. Scientific French Reader, 272.
Heysinger, I. W. The Source and Mode of Solar Energy, 704.
Hodge, Frederick Webb. List of the Publications of the Bureau of Ethnology, 275.
Huidekoper, Rush Shippen. The Cat, 562.
Jacobi, Mary Putnam. Common Sense applied to Woman Suffrage, 272.
Jones, Richard. The Growth of the Idyls of the King, 275.
Journal of the American Public Health Association, 415.
Journal of the College of Science, Imperial University, Japan. Vols. VII and VIII, 274.
Kanthack, A. A., and J. H. Drysdale. A Course of Elementary Practical Bacteriology, 564.
Kennedy, John. Must Greek go? 564.
Kersey, John A. Ethics of Literature, 854.
Keyes, Charles R. Coal Deposits of Iowa, 277.
Kitson, Arthur. A Scientific Solution of the Money Question, 707.
Knauff, Theodore C. Athletics for Physical Culture, 563.

Books noticed :

Knobel, Edward. A Guide to Find the Names of all Wild-growing Trees and Shrubs of New England by their Leaves, 706.
— Ferns and Evergreens of New England, 706.
Knowles, Edward R. The Supremacy of the Spiritual, 854
Larned, Walter C. Churches and Castles of Mediæval France, 852.
Libby, Orin G. The Geographical Distribution of the Vote of the Thirteen States on the Federal Constitution, 273.
Lodeman, E. G. Spray Calendar, 708.
Lombroso, Cæsar, and William Ferrero. The Female Offender, 848.
McCook, Henry C. American Spiders and their Spinning Work. Vol. III, 271.
Mach, Ernst. Popular Scientific Lectures, 274.
McMurrich, J. Playfair. A Text-book of Invertebrate Morphology, 413.
Martin, George H. The Evolution of the Massachusetts Public-School System, 270.
Mateer, Horace N. Evolution and Christianity, 564.
Matter, Force, and Spirit, 708.
Merriam, C. Hart. Monographic Revision of the Pocket Gophers, 273.
Merriam, L. S. Higher Education in Tennessee, 418.
Minnesota, Geological and Natural History Survey of. Twenty-second and Twenty-third Annual Reports, 553.
Minot, H. D. The Land Birds and Game Birds of New England, 853.
Missouri Botanical Garden, Fifth Annual Report of the, 133.
Missouri Geological Survey Report. Vols. IV and V, 272.
Morse, L. D. Advertiser's Handy Guide, 416.
Moses, Alfred J., and Charles L. Parsons. Elements of Mineralogy, Crystallography, and Blowpipe Analysis, 414.
Nernst, Walter. Theoretical Chemistry, 851.
New Jersey, Geological Survey of. Annual Report for 1893, 127.
— Report. Vol. III, 562.
New York Academy of Sciences, Transactions, Vol. XIII, 276.
New York Agricultural Experiment Station. Twelfth Annual Report, 134.
Newton, Alfred, and Hans Gadow. Dictionary of Birds. Part III, 419.
Nordau, Max. Degeneration, 268.
Orford, Henry. Lens Work for Amateurs, 564.
Packard, Alpheus S. The Systematic Position of the Siphonaptera, 276.
Paine, Thomas. Writings, edited by Moncure Daniel Conway. Vols. II and III, 412.
Palmer, Julius A., Jr. About Mushrooms, 131.
Pancoast, Henry S. An Introduction to English Literature, 416.
Parker, Leonard F. A History of Higher Education in Iowa, 276.
Peck, Harry T., and Robert Arrowsmith. Roman Life in Latin Prose and Verse, 854.
Perkins Institution for the Blind. Sixty-second Annual Report, 277.
Phillipson, John. The Natural History of Hell, 132.
Plummer, Fred G. Change of the Earth's Axis, 564.
Powell, J. W. Physiographic Processes, 417.
— Physiographic Features, 417.
Powell, Lyman P. History of Education in Delaware, 418.
Prinz, W. Agrandissements de Photographies lunaires, 418.
Prosser, Charles S. The Devonian System of Eastern Pennsylvania and New York, 708.
Quatrefages, A. de. The Pygmies, 130.
Rayleigh, Lord. The Theory of Sound, Vol. I, 133.
Revue Franco-Américaine. Vol. I, No. 1, 563.
Riggs, Stephen Return. Dakota Grammar, Texts, and Ethnography, 416.
Robertson, Charles. Mutual Biological Relations of the Entomophilous Flora and the Anthophilous Insect Fauna, 853.
Robinson's New Intellectual Arithmetic, 707.
Rockhill, William Woodville. A Journey through Mongolia and Tibet in 1891 and 1892, 563.
Russell, Stuart A. Electric Light Cables and the Distribution of Electricity, 562.
Russell, Thomas. Meteorology, 128.
Sabine, Stewart R., and Charles D. Lowry. Elementary Lessons in Algebra, 707.
Salt, H. S. Animal Rights, 706.
Saunders, Charles H. Handbook of Practical Mechanics, 707.
Schorlemmer, Carl. The Rise and Development of Organic Chemistry, 550.
Schultz, G., and P. Julius. Systematic Survey of the Organic Coloring Matters, 131.
Scripture, E. W. Thinking, Feeling, and Doing, 704.
Sheldon, W. L. What we mean by Duty, 564.
Smallpox in the Tenement-house Sweatshops of Chicago, 708.
Smith, Eugene A. Geological Map of Alabama, 415.
Smithsonian Institution. Report for 1892-'93, 277.
Society for Psychical Research. Proceedings, Part XXVI, 412.

Books noticed:

PAGE

South Dakota, State Board of Health of. Report for 1892, 134.
Spencer, Mr. Herbert, on the Land Question, 269.
Spurr, J. Edward. The Iron-bearing Rocks of the Mesabi Range, 708.
Standard Dictionary, A, of the English Language. Vol. II, 560.
Steiner, Bernard C. History of Education in Connecticut, 418.
— History of Education in Maryland, 418.
Stokes, Anson Phelps. Joint-metallism, 416.
Stone, Witmer. The Birds of Eastern Pennsylvania and New Jersey, 129.
Tarr, Ralph S. Economic Geology of the United States, 131.
Thomas, Allen C. A History of the United States, 273.
Thomas, Cyrus. Report on the Mound Explorations of the Bureau of Ethnology, 131.
Thompson, Silvanus P. Elementary Lessons in Electricity and Magnetism, 561.
Thurston, R. H. The Animal as a Machine and Prime Mover, 853.
Tolman, William Howe. History of Higher Education in Rhode Island, 415.
Torrey, Bradford. A Florida Sketch-book, 560.
Tracy, Frederick. The Psychology of Childhood, 563.
Trevert, Edward. Electrical Measurements, 707.
Turkey under the Sultan Abdul Hamid II, A Few Facts about, 565.
Ufer, Christian. Introduction to the Pedagogy of Herbart, 706.
United States Bureau of Ethnology. Twelfth Annual Report, 419.
— Commissioner of Fish and Fisheries. Report for 1891-'92, 277.
— Fish Commission. Bulletin. Vol. XIII, 415.
— Commissioner of Labor. Ninth Annual Report, 275.
— Geological Survey. Geological Atlas of the United States, Folios 1, 2, 3, 6, 7, 417.
University of the State of New York. Regents' Bulletin, No. 25, 418.
Vincent, Frank. Actual Africa, 702.
Walker, Francis A. General Hancock, 127.
Walker, Louisa. Varied Occupations in Weaving, 417.
Walsh, John H. Elementary Arithmetic, 416.
Ward, C. Osborne. The Equilibration of Human Aptitudes and Powers of Adaptation, 707.
Webster, Daniel. Orations, 855.
Wiley, Harvey W. Principles and Practice of Agricultural Analysis. Vol. I, 705.
Woodward, R. S. Smithsonian Geographical Tables, 414.
Yeo, John. Steam and the Marine Steam Engine, 134.
Ziwet, Alexander. Elementary Treatise on Theoretical Mechanics, 132.

British New Guinea. (Misc.) 423
Bronze-casting, Japanese. (Misc.) 429
Bronzes, Japanese, Patinas of. (Misc.) 574
Brooks, W. K. An Old Naturalist—Conrad Gesner (1516–1565) * 49
Buildings, Steel. (Misc.) 567
Büsgen, M. The Life of Water Plants 798
Business, Friendship, and Charity. L. G. McPherson 73
Buttes, Tepee and Other. (Misc.) 861

Canals, Ship, Heavy Rainfall and. (Misc.) 860
Capitan, L. Microbes as Factors in Society 103
Carbonic Acid, The Dangerous Proportion of. (Misc.) 427
Cave Exploration. (Misc.) 138
Cereals in Japan. (Misc.) 572
Chapman, Frank M. The Study of Birds Out-of-doors * 664
Childhood, Studies of. J. Sully. VIII. Fear 1
IX. Fear (*continued*) 340
X. Material of Morality 648
XI. " " (*continued*) 808
Children Lie, Why. N. Oppenheim 382
Child's, A, Thoughts about Providence. (Misc.) 566
Chinese Ideas of War. (Misc.) 137
Chitral. (Misc.) 572

PAGE
Clark, Hubert Lyman. The Motive for Scientific Research 501
Climate and Health. C. F. Taylor 213
" of the City of Mexico. (Misc.) 711
Coe, Charles H. The Armadillo and its Oddities* 354
Color-blindness, The Peril of. (Misc.) 574
Companies, Worthless, The Tricks of. (Misc.) 717
Conrad, Timothy Abbott. (With Portrait.) C. C. Abbott 257
Creation, St. Augustine and the Days of. (Misc.) 280
Criminal Anthropology. (Misc.) 858
Criticism, the Higher, From the Divine Oracles to. A. D. White.
I. The Older Interpretation 145
II. Beginnings of Scientific Interpretation 289
III. The Continued Growth of Scientific Interpretation 446
IV. The Closing Struggle 577
V. Victory of the Scientific and Literary Methods 721
Crothers, T. D. A Medical Study of the Jury System 375
Culture, Similarities in. (Misc.) 714
Cycling and the Heart. (Misc.) 142

Dana, Prof., Death of. (Misc.) 279
Dates, Cultivation of, at Tafilet. (Misc.) 863
Davenport, Gertrude Crotty. Variation in the Habits of Animals 619
Disease, Oysters and. (Misc.) 282
Doggish Sympathy. (Misc.) 136

Earth, The Bowels of the.* A. C. Lane 302
" Wabbling of the. (Misc.) 280
Earthquake Motion, Rapid Transmission of. (Misc.) 424
Earth's School of Enterprise, The. (Misc.) 428
Education, Public, and Public Opinion. (Editor's Table) 122
" Sham. (Editor's Table) 699
" The Nervous System and its Relation to. J. Ferguson 528
" The Physical Element in. E. L. Richards 471
Eight-hour System, The, in Practice. (Misc.) 285
Electric Cooking Vessels. (Misc.) 714
Engravings, Steel, as Works of Art. (Corr.) G. G. Bohn 121
Ethics, Applied, Plymouth School of. (Misc.) 140
Evans, E. P. Recent Recrudescence of Superstition. I 761
Evermann, Barton Warren. Two-Ocean Pass* 175
Evolution, Human, The Work of Ideas in. G. Le Bon 541
" in 1858. (Corr.) H. F. Osborn 264
" Social. (Editor's Table) 409
" " Kidd on. W. D. Le Sueur 38

Faces, Trades and. L. Robinson 627
Falkenhorst, C. Only a Match 683
Farmer, Friends of the. (Misc.) 710
Farming on the Yang-tse Kiang. (Misc.) 574
Féré, Charles. Morbid Heredity 388
Ferguson, John. The Nervous System and its Relation to Education. 528

PAGE
Filters, Unsanitary. (Misc.) ... 715
Fingers, Webbed, An Instance of, in Man.* (Misc.) ... 856
Finland, Science in. (Misc.) ... 566
Fires, Apparatus for Extinguishing.* J. G. Morse ... 477, 603
Fjords, Fjörds, and Fohrden. (Misc.) ... 138
Flint Implement Factory, An Ancient. (Misc.) ... 284
Flowers and their Unwelcome Visitors. (Misc.) ... 426
Forests and Climate. (Misc.) ... 139
Foster, Michael. Thomas Henry Huxley ... 776
Franklin Institute, Scientific Work of the. (Misc.) ... 861
French Science, A Generation of. (Misc.) ... 428
Fruit as a Food and Medicine. H. Benjafield ... 677

Geological Study, Recent, Characteristics of. (Misc.) ... 568
Gesner, Conrad (1516–1565), An Old Naturalist.* W. K. Brooks ... 49
Gothenburg System, The. (Misc.) ... 425

Harley, Lewis R. Race Mixture and National Character ... 86
Herbaria in their Relation to Botany. J. P. Lotsy ... 360
Heredity, Morbid. C. Féré ... 388
Hitchcock, Edward. (With Portrait) ... 689
Honor not Honors. (Editor's Table) ... 558
Hosack, David, Sketch of ... 834
House, Making the, Healthful. (Misc.) ... 573
Howe, Lucien. Art and Eyesight* ... 458
Human Classifications, Prof. Sergi's. (Misc.) ... 141
Huxley, Prof. (Editor's Table) ... 557
" Thomas Henry. M. Foster ... 776
Hypnotism, Therapeutic. (Misc.) ... 712

Indian Bows, Arrows, and Quivers. (Misc.) ... 140
Industries, American, Development of, since Columbus. XIX. Apparatus for Extinguishing Fires.* J. G. Morse ... 477, 603
Industries, Chemistry advanced by the. (Misc.) ... 857
Insects, Snow-coloring. (Misc.) ... 859
Irrigation of the Nile Valley. (Misc.) ... 573

James, Frank L. A Prediction of the Phonograph. (Corr.) ... 265
Jordan, David Starr. To Bárbara. (With Portrait) ... 538
Jury System, A Medical Study of the. T. D. Crothers ... 375

Korean Hats. (Misc.) ... 571
Koreans, The. (Misc.) ... 283

Labrador and Alaska, Explorations in. (Misc.) ... 859
Lane, Alfred C. The Bowels of the Earth* ... 302
Lead, White, Substitute for. (Misc.) ... 427
Le Bon, Gustave. The Work of Ideas in Human Evolution ... 541
Le Sueur, W. D. Kidd on Social Evolution ... 38
Library, A Model Public. (Misc.) ... 284

PAGE
Life Zones, American. (Misc.) 569
Light, the Acetylene, Qualities of. (Misc.) 141
" Unsolved Problems in the Manufacture of. (Misc.) 709
Lightning, Overhead Wires and. (Misc.) 429
Lotsy, John P. Herbaria in their Relation to Botany 360
Lu Chu Islands Politics. (Misc.) 421
Lusk, William T. The Illustrious Boerhaave.* (With Portrait) 110
Luxury, The Office of. P. L. Beaulieu 25

McAdie, Alexander. Natural Rain-makers* 642
Macdougal, D. T. Irritability and Movement in Plants* 225
McPherson, Logan G. Business, Friendship, and Charity 73
Madagascar, Journeying in.* F. Vincent 239
Marriages, Korean. (Misc.) 424
Match, Only a. C. Falkenhorst 683
Mather, Fred. Trout Culture* 749
Maya Hieroglyphics, A Study of. (Misc.) 137
Mental Action, The Weather and. (Misc.) 568
Microbes as Factors in Society. L. Capitan 103
Militarism, The Spirit of. A. B. Ronne 234
Milk, Diphtheria and. (Misc.) 712
Minot, Charles Sedgwick. The Work of the Naturalist in the World. 60
Monkey's Caprices, A. (Misc.) 141
Morally Defective, Treatment of the. (Misc.) 279
Morris, Charles. War as a Factor in Civilization 823
Morse, John G. Apparatus for Extinguishing Fires* 477, 603
Museum, the Peabody, Work of. (Misc.) 281
Music, Physiological Influence of. (Misc.) 430

Naturalist, The Work of the, in the World. C. S. Minot 60
Nature, Undisturbed. (Misc.) 421
Newcomb, H. T. The Decline in Railway Charges 186
Nickel Mines, American. (Misc.) 424

Obituary Notes. W. S. W. Ruschenberger, Sir Henry Rawlinson, Jules Reynauld, F. Schmitz, J. Owen Dorsey, Gerhard Krüss, D. Hack Tuke, George Newbold Lawrence, T. P. Kirkman 144
John Newton, George A. Rex 288
Julius Lothar Meyer, Karl Ludwig, Carl Vogt, Daniel Kirkwood 432
Thomas Henry Huxley, William C. Williamson 576
Franz Neumann, Valentine Ball, Theodore Brorsen 720
Valentine Ball, —— Baillon, Friedrich Tietjen, Friedrich Wilhelm Gustav Spörer 864
Object Lessons, The Value of. (Misc.) 716
Opium, Report on. (Misc.) 567
Oppenheim, Nathan. Why Children Lie 382
Oysters, Sewer-fed. (Misc.) 428
Osborn, Henry F. Evolution in 1858. (Corr.) 264

Pamirs, The. (Misc.) 283
Patrick, G. T. W. The Psychology of Woman 200

PAGE
Professional Institutions. H. Spencer. I. Professions in General.... 34
II. Physician and Surgeon..... 164
III. Dancer and Musician..... 364
IV. Orator and Poet, Actor and Dramatist..... 433
V. Biographer, Historian, and Litterateur..... 594
VI. Man of Science and Philosopher..... 739
Phonograph, A Prediction of the. (Corr.). F. L. James..... 265
Photography, Color. (Misc.)..... 716
Physical Measurements of School Children. (Misc.)..... 712
Pictures, Sunlight and. (Misc.)..... 716
Pimento. (Misc.)..... 717
Plant-growing, Electricity and. (Misc.)..... 422
Plants, Irritability and Movement in.* D. T. Macdougal..... 225

Race Mixture and National Character. L. R. Harley..... 86
Railway Charges, The Decline in. H. T. Newcomb..... 186
" The Great Siberian. (Misc.)..... 711
Rain-makers, Natural.* A. McAdie..... 642
Ramie Cultivation, Revival of. (Misc.)..... 429
Red Cross, The. (Misc.)..... 709
Richards, Eugene L. The Physical Element in Education..... 471
Robinson, Louis. Trades and Faces..... 627
Ronne, A. B. The Spirit of Militarism..... 234

Sand Blast, Uses of the. (Misc.)..... 713
Science and Nescience (Editor's Table)..... 843
" Teaching, Uses of. (Misc.)..... 569
" The Alleged Dogmatism of. (Editor's Table)..... 124
" The Sphere of. (Editor's Table)..... 554
Scientific Advance, The Path of. (Editor's Table)..... 845
" Research, The Motive for. H. L. Clark..... 501
Seeds, The Vitality of. (Misc.)..... 862
Selection, Natural, The Office of. (Misc.)..... 284
Serviss, Garrett P. Pleasures of the Telescope. V. In Summer Starlands*..... 194
VI. From Lyra to Eridanus*..... 508
VII. Pisces, Aries, Taurus, and the Northern Stars*..... 783
Shepard, Charles Upham, Sketch of. (With Portrait)..... 548
Sleep. Conditions of. (Misc.)..... 430
Smoke. (Misc.)..... 712
Smoking in Mashonaland. (Misc.)..... 570
Snake-bite Antitoxine. (Misc.)..... 715
Snake, Lu Chu Island. (Misc.)..... 711
Socialism, The Prospects of. (Editor's Table)..... 697
Songs, Modoc. (Misc.)..... 569
Spencer, Herbert. Mr. Balfour's Dialectics..... 327
" " Professional Institutions. I. Professions in General. 34
II. Physician and Surgeon..... 164
III. Dancer and Musician..... 364
IV. Orator and Poet, Actor and Dramatist..... 433
V. Biographer, Historian, and Litterateur..... 594

PAGE
Spencer, Herbert. Professional Institutions. VI. Man of Science and Philosopher 739
Spencer on Professional Institutions. (Editor's Table) 125
Spiders, The Vision of. (Misc.) 422
Stalactites, Formation of. (Misc.) 714
Starr, Frederick. Archæology in Denmark * 12
Stars, Hot, Protoplasm for. (Misc.) 136
Stoddard, John Tappan. Argon : the New Constituent of the Air 522
Stone Arrowheads, How they were Made. (Misc.) 857
Sully, James. Studies of Childhood. VIII. Fear 1
IX. Fear (*continued*) 340
X. Material of Morality 648
XI. " " (*continued*) 808
Sun-worship, Survivals of. F. D. Bergen 249
Superstition, Recent Recrudescence of. I. E. P. Evans 761
Superstitions, Petty, Power of. (Misc.) 859
" North Nyassa. (Misc.) 862

Taylor, Charles Fayette. Climate and Health 313
Telescope, Pleasures of the. G. P. Serviss. V. In Summer Star-lands * 194
VI. From Lyra to Eridanus * 508
VII. Pisces, Aries, Taurus, and the Northern Stars * 783
Thomson, Basil H. Ancestor-worship among the Fijians 671
Torture, The Passing of. (Misc.) 282
Trout Culture.* F. Mather 749
Tuberculosis in Meat. (Misc.) 713
Tuke, Dr. Daniel Hack. (With Portrait) 625
Two-Ocean Pass.* B. W. Evermann 175

Variation, Human, Significance of 710
Ventilation, House and Room. (Misc.) 860
Vincent, Frank. Journeying in Madagascar * 239
Voice, the Human, Range of. (Misc.) 858

War as a Factor in Civilization. C. Morris 823
Water Plants, The Life of. M. Büsgen 798
Waves, Lord Rayleigh on. (Misc.) 239
Woman as an Inventor and Manufacturer * 92
" The Psychology of. G. T. W. Patrick 209
" American, in Science. (Misc.) 283
White, Andrew D. From the Divine Oracles to the Higher Criticism.
I. The Older Interpretation 145
II. Beginnings of Scientific Interpretation 289
III. The Continued Growth of Scientific Interpretation 446
IV. The Closing Struggle 577
V. Victory of the Scientific and Literary Methods 721
White's, Dr., New Chapters, Conclusion of. (Editor's Table) 267
Wire, Uses of. (Misc.) 571

END OF VOL. XLVII.

MACMILLAN & CO.'S NEW PUBLICATIONS.

New Volume of the COLUMBIA UNIVERSITY BIOLOGICAL SERIES.

Edited by HENRY FAIRFIELD OSBORN, *Da Costa Professor of Biology in Columbia College.*

Fishes, Living and Fossil.

An Outline of their Form and Probable Relationship.

By BASHFORD DEAN, Ph. D. Columbia, *Instructor in Biology, Columbia College.*

With Illustrations from the Author's original Pen Drawings. 8vo, cloth, $2.50 *net.*

ALREADY PUBLISHED IN THE SAME SERIES:

From the Greeks to Darwin.

The development of the Evolution idea. By HENRY FAIRFIELD OSBORN, Sc. D. Princeton, *Da Costa Professor of Biology in Columbia College.* 8vo, cloth, $2.00 *net.*

Amphioxus and Ancestry of the Vertebrates.

By ARTHUR WILLEY, B. Sc. Lond., *Tutor in Biology, Columbia College, Balfour Student of the University of Cambridge. With Illustrations.* 8vo, cloth, $2.50 *net.*

New Volume.—COLUMBIA UNIVERSITY PRESS.

Atlas of the Fertilization and Karyokinesis of the Ovum.

By EDMUND B. WILSON, Ph. D., *Professor of Invertebrate Zoölogy in Columbia College,* with the co-operation of EDWARD LEAMING, M. D., F. R. P. S., *Instructor in Photography at the College of Physicians and Surgeons, Columbia College. Illustrated with forty figures photographed from Nature by Dr. Leaming, from the preparations of Professor Wilson at an enlargement of one thousand diameters, and mechanically reproduced by the gelatine process without retouching, by Edward Bierstadt of New York. The plates are accompanied by an explanatory text, giving a general introduction to the subject for the use of students and general readers, a detailed description of the photographs, and over sixty text figures from camera-drawings.* 8vo, cloth, $4.00 *net.*

Nitti.—Catholic Socialism.

By FRANCESO S. NITTI, Professor of Political Economy at the University of Naples, author of "Population and the Social System," etc. Translated from the second Italian edition by MARY MACKINTOSH. With an Introduction by DAVID G. RITCHIE, M. A., Professor of Logic and Metaphysics in the University of St. Andrews. Pp. xx+432, 8vo, cloth, $3.50.

Lindsay.—An Introduction to the Study of Zoology.

By B. LINDSAY, C. S. of Girton College, Cambridge. With 124 Illustrations and Diagrams. Pp. xix+356, 12mo, cloth, $1.60 *net.*

Cooke, Shipley, and Reed.—Molluscs and Brachiopods.

By Rev. A. H. COOKE, M. A., Fellow of King's College, Cambridge; A. E. SHIPLEY, M. A., Fellow of Christ's College, Cambridge; and F. R. C. REED, B. A., Trinity College, Cambridge. Illustrated. *Cambridge Natural History.* 8vo, cloth, pp. 535, $3.25 *net.*

"Written in the true spirit of the Alpine climber."

The Alps from End to End.

By Sir WILLIAM MARTIN CONWAY. With 100 Illustrations by A. D. MCCORMICK. Large demy 8vo, cloth, $7.00.

THE RURAL SCIENCE SERIES.

Edited by L. H. BAILEY. New Volume.

King.—The Soil.

Its Nature, Relations, and Fundamental Principles of Management. By F. H. KING, Professor of Agricultural Physics in the University of Wisconsin. 16mo, cloth, 75 cents.

Jackson.—The Great Frozen Land.

Narratives of a Winter Journey across the Tundras and a Sojourn among the Samoyads. By GEORGE F. JACKSON, Fellow of the Royal Geographical Society and Leader of the Jackson-Harmsworth Polar Expedition. With Illustrations and Maps. Edited from his Journals by ARTHUR MONTEFIORE. 8vo, cloth, pp. xviii+297, $4.50.

Wright.—Birdcraft.

A Field Book of Two Hundred Song, Game, and Water Birds. By MABEL OSGOOD WRIGHT. With numerous full-page Plates, containing 128 Birds in the Natural Colors, and other Illustrations. 8vo, bound in linen, $3.00 *net.*

"An Arctic Adventure."

Ice-Bound on Kolguev.

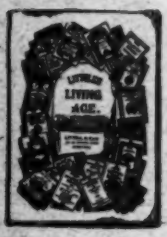
By AUBYN TREVOR-BATTYE, F. L. S., F. Z. S., etc. With numerous Illustrations and Drawings, and Three Maps. Large 8vo, cloth, gilt top, $7.00.

MACMILLAN & CO., 66 Fifth Avenue, New York.

"A Weekly Feast to Nourish Hungry Minds."—*New York Evangelist.*

LITTELL'S LIVING AGE,

A WEEKLY MAGAZINE OF



FOREIGN PERIODICAL LITERATURE

Giving yearly 3300 Double-Column Octavo Pages of Matter (making Four Large Volumes) Unequaled in Quality and Quantity.

THE ABLEST MINDS OF THE AGE

CONTRIBUTE TO MAKE THIS PERIODICAL

Encyclopedic in Scope, Character, Completeness, Comprehensiveness.

INDISPENSABLE

To every Reader of Intelligence and Literary Taste.

Every intelligent reader will find in

THE LIVING AGE

Food to Nourish, Stimulate, and Inspire Thought.

THE ABLEST AND BRIGHTEST MEN
AND WOMEN OF THE WORLD
HAVE READ AND COMMENDED IT DURING MORE THAN HALF A CENTURY.

"**Exhaustive Reviews** of recent publications, the latest results of **Scientific Research, Biographical Sketches** of eminent characters, **Travel, Exploration, Literary Criticism,** and every phase of **Culture and Progress** in Europe, **Fiction** and **Choice Poetry**—all these make up **THE LIVING AGE.**"

—*Evening Bulletin* (Philadelphia).

TRIAL SUBSCRIPTION.

As a special inducement to any who desire to make a trial subscription, we will send the weekly issues for the last six months of this year (July to December inclusive) for $3.00; or, for $6.00, we will send the numbers for the year 1895.

THE LIVING AGE is published **Weekly** at $8.00 a year, free of postage.

Address, **LITTELL & CO., 31 Bedford Street, Boston.**

LATEST PUBLICATIONS OF D. APPLETON & CO.

NEW YORK, OCTOBER, 1895.

Gustave Flaubert,

As seen in his Works and Correspondence. By JOHN CHARLES TARVER. With Portrait. 8vo. Buckram, $4.00.

No one who is genuinely interested in literature can afford to neglect this much-needed and valuable book. It furnishes both a critical biography and, in a sense, an autobiography, for the letters permit a more intimate acquaintance with the spirit and aims of the great realist. The interesting personages who appear here and there in these pages and the author's associations increase the value of one of the most important literary biographies of recent years.

"It is surprising that this extremely interesting correspondence has not been Englished before."—*London Athenæum.*

"This handsome volume is welcome. . . . It merits a cordial reception if for no other reason than to make a large section of the English public more intimately acquainted with the foremost champion of art for art's sake. . . . The letters are admirably translated, and in the main the book is written with skill and *verve*."—*London Academy.*

The Stark Munro Letters.

Being a Series of Twelve Letters written by J. STARK MUNRO, M. B, to his Friend and Fellow-Student, Herbert Swanborough, of Lowell, Mass, 1881–1884. Edited and arranged by A. Conan Doyle, author of "Round the Red Lamp," "The Adventures of Sherlock Holmes," etc. With 8 full-page Illustrations. 12mo. Cloth, $1.50.

This original and dramatic story presents fresh types, extraordinary situations, and novel suggestions with a freshness and vigor which show that the romancer's heart was in his work. How far certain incidents of the story are based upon personal experiences it is impossible to say, but the unflagging interest and unexpected phases of the romance are no less in evidence than the close personal relations established between author and reader.

The Beginnings of Writing.

By WALTER J. HOFFMAN, M. D., of the Bureau of American Ethnology, Smithsonian Institution. A new volume in the Anthropological Series. Edited by Prof Frederick Starr. Illustrated. 12mo. Cloth, $1.75.

Professor Hoffman, one of the most successful workers in the field of American ethnology, presents the first steps in the development of writing from tangible reminders like quipus and wampum belts, through picture writing to phonetic writing with an alphabet. These first steps are described especially as they are shown among North American tribes. Our native peoples made much use of reminders; they drew truly expressive pictures; they developed complicated systems of pictography; and some peoples of Mexico and Central America were passing from the use of ideograms to phonograms. This transition period is most interesting. In clear and popular language Professor Hoffman sets forth the latest results of scientific study, and his references are illustrated with many helpful pictures.

Practical Dietetics,

With Special Reference to Diet in Disease. By W. GILMAN THOMPSON, M. D., Professor of Materia Medica, Therapeutics, and Clinical Medicine in the University of the City of New York; Visiting Physician to the Presbyterian and Bellevue Hospitals. 8vo. Cloth, $5.00; sheep, $6.00. (Sold by subscription.)

This work is eminently practical, and deals with the application of dietetics to diseases that are influenced by proper feeding in a more thorough manner than is adopted in any known work on the subject. It covers a field heretofore practically unoccupied, and will prove of invaluable aid to the physician, the trained nurse, and in the home.

The Mottoes and Commentaries of Friedrich Froebel's Mother Play.

"Mother Communings and Mottoes" rendered into English Verse by HENRIETTA R. ELIOT, and "Prose Commentaries" translated by SUSAN E. BLOW. With 48 full-page Illustrations. Vol. 31, International Education Series. 12mo. Cloth, $1.50.

The increased interest in kindergarten work and the demand for a clearer exposition of Froebel's philosophy than has heretofore appeared have made a new version of the "Mother Play" an imperative necessity. No one is better equipped for such a work than Miss Blow, as her late book, "Symbolic Education," has attested. In the "Mottoes and Commentaries" the original pictures have been faithfully reproduced, except where bad drawing rendered slight changes necessary. It is an attractive volume of a convenient size, and a book of specific value to mothers as well as to teachers of every grade. It will be followed shortly by another volume containing the songs and games.

The Psychology of Number,

And its Applications to Methods of Teaching Arithmetic. By JAMES A. MCLELLAN, A. M., LL. D., Principal of the Ontario School of Pedagogy, Toronto, and JOHN DEWEY, Ph. D., Head Professor of Philosophy in the University of Chicago. 12mo. Cloth, $1.50.

It is believed that this work will supply a special want. There is no subject taught in the elementary schools that taxes the teacher's resources as to methods and devices to a greater extent than arithmetic. There is no subject taught that is more dangerous to the pupil in the way of deadening his mind and arresting its development, if bad methods are used. The authors of this book have presented in an admirable manner the psychological view of number, and shown its applications to the correct methods of teaching the several arithmetical processes.

The Manual of Arms.

Adapted to the Rifle, Caliber .30, recently adopted by the U. S. Army. 16mo. Paper, 10 cents.

This pamphlet consists of modifications in the Drill Regulations and Manual of Guard Duty, established provisionally for the government of the Army pending a complete revision of the Infantry Drill Regulations.

The Watter's Mou'.

By BRAM STOKER. 16mo. Cloth, 75 cents.

This is a singularly dramatic story of the English coast, worked out with excellent command of forceful motives and an abundant power of graphic description.

The Red Badge of Courage.

An Episode of the American Civil War. By STEPHEN CRANE. 12mo. Cloth, $1.00.

Within the last year or two Mr. Crane has made himself felt as a new force to be reckoned with in our literature, and the original quality of his stories and verses has been recognized by critics and readers. This new book, his most important work in prose, will be found to show a concentration of his powers and a riper expression of his talent. The theme is one which should appeal to every American. For an equally searching and graphic analysis of the volunteer in battle, one is tempted to turn to certain pages of Tolstoy. Mr. Crane puts before us the reality of war as it appeared to the soldier, and the interest of his picture is intense and absorbing.

European and American Cuisine.

By GESINE LEMCKE, author of "Desserts and Salads," and Principal of the Brooklyn Cooking College. Small 8vo. Cloth, $2.00.

"The housekeeper who desires to keep up with the times will certainly wish to add Mrs. Lemcke's book to her culinary library."—*Boston Beacon.*

"For practical recipes it is perhaps without a competitor."—*New York World.*

"Mrs Lemcke has done a great deal to help toward domestic bliss, kind and noble deeds, and the progress of civilisation."—*New York Press.*

Handbook of Sanitary Information for Householders.

By ROGER S. TRACY, M. D., Sanitary Inspector of the New York City Health Department. New edition. 16mo. Cloth, 50 cents.

"Written in an extremely simple, didactic style, and packed with information of the greatest value and interest. The merit of the book, the importance of the subject, and the low price should put it in the hands of every householder."—*Cincinnati Tribune.*

"A great deal of material has been condensed and rearranged here, and it will not be Dr. Tracy's fault if citizens are not the gainers by his handbook."—*Philadelphia Ledger.*

"The value of the book lies largely in its explicitness, and in the fact that simple tests and remedies are described, that at trifling expense could be applied and determine the necessity of a plumber."—*Cleveland World.*

The Story of the Plants.

By GRANT ALLEN. A new volume in the Library of Useful Stories. Illustrated. 16mo. Cloth, 40 cents.

"The author has wasted comparatively little space on mere structural detail, and has dwelt as much as possible on those more interesting features in the interrelation of the plant and animal worlds which have vivified for us of late years the dry bones of the old technical botany. It is a most interesting and instructive work."—*Boston Budget.*

"The student of plants can learn more practical knowledge from this little volume than from the most elaborate botanical text-book."—*New York Observer.*

The Story of "Primitive" Man.

By EDWARD CLODD, author of "The Story of Creation," etc. Library of Useful Stories. Illustrated. 16mo. Cloth, 40 cents.

This volume presents the results of the latest investigations into the early history of the human race. The value of an up-to-date summary like this is especially marked in view of the interest of the subject. Like the successful "Story of the Stars," this book is written in clear, concise language, as free as possible from technical words and phrases. The author is a recognized authority, and his lucid text is accompanied by a large number of attractive illustrations.

The Female Offender.

By Prof. CÆSAR LOMBROSO and WILLIAM FERRERO. The first volume in the Criminology Series, edited by W. DOUGLAS MORRISON. Illustrated. 12mo. Cloth, $1.50.

"A book of strong conclusions, and no one who reads it will wonder that it should have excited wide interest and discussion."—*New York Sun.*

"There is no book of recent issue that bears such important relation to the great subject of criminology as this book."—*New Haven Leader.*

The Art of Newspaper Making.

Three Lectures. By CHARLES A. DANA. 16mo. Cloth, $1.00.

The art of making a newspaper that is read is one of which Mr. Dana has proved himself a past master. Those who follow his calling will turn to his book to discover the secret. Those who read newspapers—and this is a nation of newspaper readers—will feel a lively interest in the views and experiences of the dean of American newspaper makers.

An Aide-de-Camp of Napoleon.

Memoirs of General COUNT DE SÉGUR, of the French Academy, 1800–1812. Revised by his Grandson, COUNT LOUIS DE SÉGUR. Uniform with Méneval's Memoirs. With frontispiece. 8vo. Cloth, $2.00.

"No recent work of which the present fashion for Napoleonic literature has witnessed the publication either in the shape of translations from the French or of original monographs on his famous battles, is likely to interest a larger class of intelligent readers than 'An Aide-de-Camp of Napoleon.'"—*New York Mail and Express.*

LATEST ISSUES IN

Appletons' Town and Country Library.

No. 177. Scylla or Charybdis?

A Novel. By RHODA BROUGHTON, author of "A Beginner," etc. 12mo. Paper, 50 cents; cloth, $1.00.

The new story by this popular author will be found full of human interest, agreeable and entertaining.

No. 176. Out of Due Season.

A Mezzotint. By ADELINE SERGEANT. 12mo. Paper, 50 cents; cloth, $1.00.

The development of Miss Sergeant's power is well shown in this strong and significant study of life and character.

No. 175. Not Counting the Cost.

By TASMA. 12mo. Paper, 50 cents; cloth, $1.00.

"There is an insight into motives, a keen analysis of the grand passion which stamps the author as having what is essential to the great novel writer—genius."—*Boston Advertiser.*

"People who care for stories will be sure to like this one."—*Brooklyn Eagle.*

No. 174. Mrs. Musgrave—and Her Husband.

By RICHARD MARSH. 12mo. Paper, 50 cents; cloth, $1.00.

"A powerful story, with dramatic plot, exciting situations, sustaining the intense interest of the reader from beginning to end. It is, in fact, one of the most thrilling, interesting novels of the season."—*Boston Advertiser.*

"There is an intensity in the novel which is kept taut throughout. It is certainly a remarkable story, and interesting."—*Milwaukee Journal.*

No. 173. In Old New England.

The Romance of a Colonial Fireside. By HEZEKIAH BUTTERWORTH, author of "The Patriot Schoolmaster," "In the Boyhood of Lincoln," etc. 12mo. Paper, 50 cents; cloth, $1.00.

"The romantic phases of New England life are perhaps better known to Mr. Butterworth than to any other writer of the day, and the richness of his discoveries will delight every reader of this volume."—*Boston Home Journal.*

"We do not remember any other volume than Mr. Butterworth's which holds within its covers a series of such charming legends and traditions of New England's earlier history. . . . It possesses a charm rare indeed."—*New York Mail and Express.*

No. 172. In the Year of Jubilee.

By GEORGE GISSING, author of "Eve's Ransom," "Denzil Quarrier," etc. 12mo. Paper, 50 cents; cloth, $1.00.

"The best novel of the year."—*New York Commercial Advertiser.*

"A novel of uncommon power and fine insight. By far the most interesting English novel of the year."—*New York Commercial Advertiser.*

"Well worth reading, and must stand high in contemporaneous novel literature."—*Chicago Times-Herald.*

No. 171. The Mistress of Quest.

By ADELINE SERGEANT. 12mo. Paper, 50 cents; cloth, $1.00.

"A notable novel, written with all the ease of the accomplished story-teller."—*London Globe.*

"A novel that is bound to sustain its author's well-merited reputation as a writer of forcible and fascinating fiction."—*London Telegraph.*

"A good story, charmingly told. A delightful novel for summer reading."—*Minneapolis Press.*

☞ *This Bulletin of new publications is issued on the first of each month, and will be regularly mailed to any address, gratis, upon request. Address* D. APPLETON & CO., 72 Fifth Avenue, NEW YORK.

JOHN FISKE'S WORKS.

AMERICAN HISTORY.

The Discovery of America. With some account of Ancient America and the Spanish Conquest. With a steel portrait of Mr. Fiske, many maps, facsimiles, etc. *Thirteenth thousand.* 2 vols., crown 8vo, gilt top, $4.00.

"A very cyclopædia of information on all subjects connected with its main theme, written by a man whose grasp is comprehensive, and whose knowledge is commensurate with his grasp."—*London Times.*

The American Revolution. With Plans of Battles and a new steel portrait of Washington. *Tenth thousand.* 2 vols., crown 8vo, gilt top, $4.00.

The Critical Period of American History, 1783-1789. With a colored map. *Sixteenth thousand.* Crown 8vo, gilt top, $2.00.

The War of Independence. In *Riverside Library for Young People.* Maps. *Twenty-second thousand.* 75 cents.

The Beginnings of New England. *Twelfth thousand.* Crown 8vo, gilt top, $2.00.

History of the United States, for Schools. Very fully illustrated with maps, portraits, etc. *Thirtieth thousand.* 12mo, $1.00 *net.*

Admirable for school use, while the fullness of its information and the charm of its style make it peculiarly interesting for general readers

Civil Government in the United States. With some reference to its origins. *Seventy-fourth thousand.* 12mo, $1.00 *net.*

"The reader may turn over these volumes with full assurance of faith for a fresh rehearsal of the old facts, which no time can stale, and for new views of those old facts, according to the larger framework of ideas in which they can now be set by the master of a captivating style and an expert in historical philosophy."—*New York Evening Post.*

ESSAYS AND PHILOSOPHY.

Outlines of Cosmic Philosophy. Based on the Doctrine of Evolution. *Fifteenth edition.* 2 vols., 8vo, gilt top, $6.00.

Myths and Myth-Makers. Old Tales and Superstitions interpreted by Comparative Mythology. *Nineteenth edition.* Crown 8vo, gilt top, $2.00.

Darwinism and Other Essays. *Tenth edition.* Crown 8vo, gilt top, $2.00.

Excursions of an Evolutionist. *Sixteenth edition.* Crown 8vo, gilt top, $2.00.

The Unseen World and Other Essays. *Thirteenth edition.* Crown 8vo, gilt top, $2.00.

The Destiny of Man, Viewed in the Light of His Origin. *Twenty-first edition.* Crown 8vo, gilt top, $1.00.

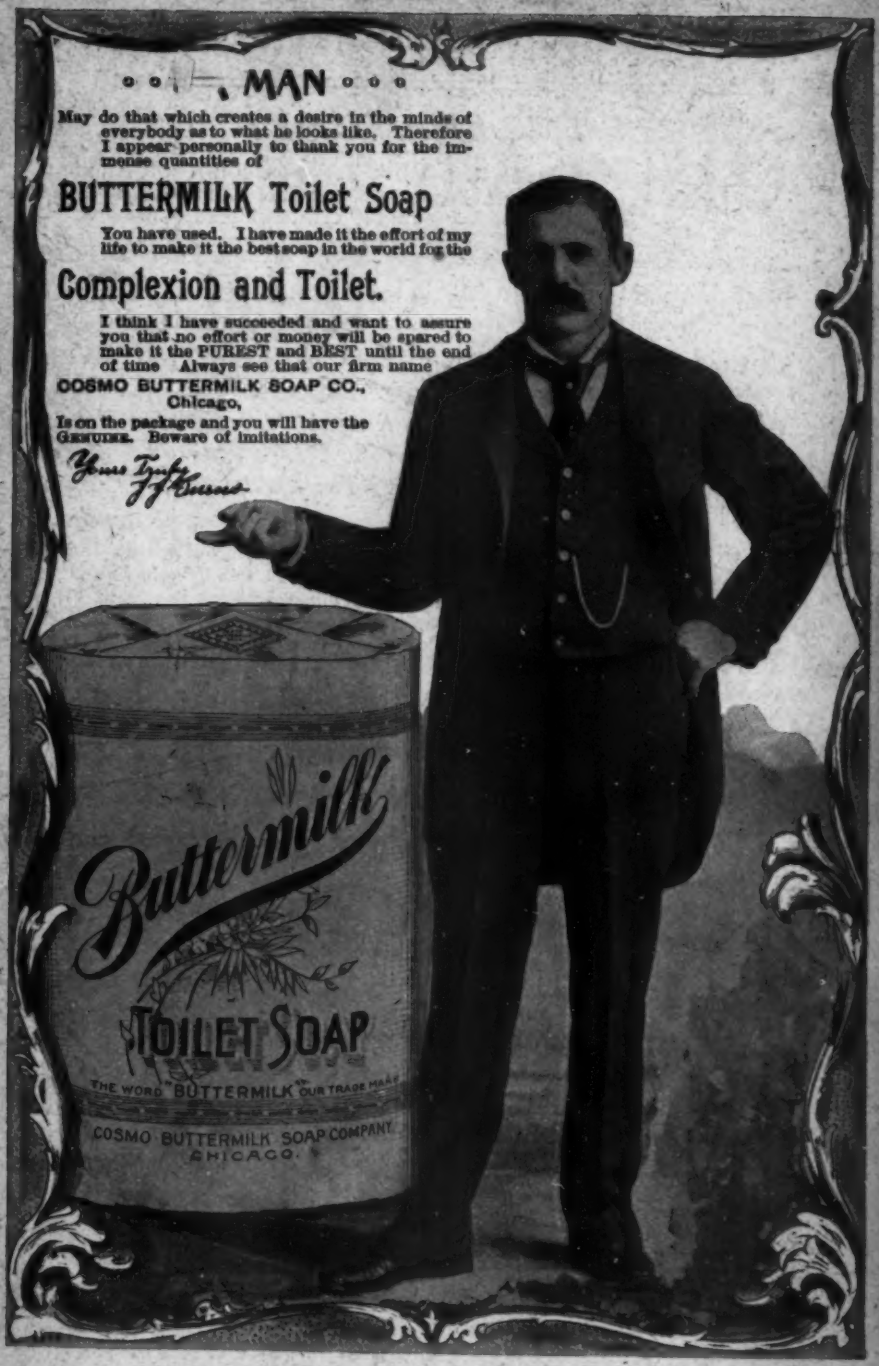
The Idea of God as Affected by Modern Knowledge. *Fifteenth thousand.* 16mo, gilt top, $1.00.

"Among our thoughtful essayists there are none more brilliant than Mr. John Fiske. His pure style suits his clear thought. He does not write unless he has something to say; and when he does write he shows not only that he has thoroughly acquainted himself with the subject, but that he has to a rare degree the art of so massing his matter as to bring out the true value of the leading points in artistic relief. It is this perspective which makes his work such agreeable reading even on abstruse subjects."—*The Nation* (New York).

*** *For sale by all Booksellers. Sent postpaid, on receipt of price by the Publishers,*

HOUGHTON, MIFFLIN AND COMPANY,

4 PARK STREET, BOSTON; 11 EAST 17TH STREET, NEW YORK.


MAN
May do that which creates a desire in the minds of everybody as to what he looks like. Therefore I appear personally to thank you for the immense quantities of
BUTTERMILK Toilet Soap
You have used. I have made it the effort of my life to make it the best soap in the world for the
Complexion and Toilet.
I think I have succeeded and want to assure you that no effort or money will be spared to make it the PUREST and BEST until the end of time Always see that our firm name
COSMO BUTTERMILK SOAP CO.,
Chicago,
Is on the package and you will have the GENUINE. Beware of imitations.
Yours Truly
Buttermilk
TOILET SOAP
THE WORD "BUTTERMILK" OUR TRADE MARK
COSMO BUTTERMILK SOAP COMPANY
CHICAGO.

Packer's Tar Soap.

PURE, MILD, EMOLLIENT, BALSAMIC.

For the Complexion A delightful cleanser; refreshing and grateful to the skin, leaving it smooth and supple, with improved tint. Its use purifies the pores, and prevents and removes blackheads. In irritated conditions of the skin due to chafing, perspiration, heat, bites and stings, etc., it soothes, heals, and is invaluable.

For Shampooing It removes dandruff, allays itching, promotes healthful growth of the hair, and keeps it soft and lustrous. It is the shampooing agent recommended by physicians and used by the best hair-dressers.

"A Luxury for Bath and Shampoo."

Medical Standard.

LATELY PUBLISHED.

KERNER AND OLIVER'S NATURAL HISTORY OF PLANTS. From the German of ANTON KERNER VON MARILAUN, Professor in the University of Vienna. By F. W. OLIVER, Professor in University College, London. With 1,000 Wood Engravings, mostly original, and 16 colored Plates. 4to. 2 vols. Now ready: Vol. I (bound in two parts), and Part I, Vol. II, $11.25. Part II, Vol. II, completing the work, ready in October.

A work for reference or continuous reading, at once popular and, in the modern sense, thoroughly scientific. The results of the latest studies in the whole range of plant life are accurately detailed, with studied avoidance of needless technicalities, and with an astonishing wealth of illustration. Typical plants are shown in their natural surroundings; the story of the life of each is told—how its food supply is obtained and transformed into its own substance; how it grows, adapts itself to its environment, reproduces itself, and dies.

GRANT ALLEN: "It is full of new and important views; the style is fascinating, and the exposition of the subject philosophical and masterly. I can conceive of no book more likely to give an intelligent inquirer a firm grasp of the leading principles of life on our globe. It is a treasure-house of knowledge."

President J. M. COULTER, *in the Dial:* "Professor Kerner has done what more botanists should do; he has brought the most recent researches within reach of the intelligent reader, and in a style so charming that even the professional teacher may learn a lesson in the art of presentation. . . . It is such books as this that will bring botany fairly before the public as a subject of absorbing interest; that will illuminate the botanical lecture room; that will convert the Gradgrind of our modern laboratory into a student of Nature; that will help carry us through the regions of analysis to those of synthesis, where lies the real domain of science."

McMURRICH'S TEXT-BOOK OF INVERTEBRATE MORPHOLOGY. By J. PLAYFAIR MCMURRICH, Ph. D., Professor in the University of Michigan. vii + 661 pages. 8vo. $4.00 net.

C. O. WHITMAN, *Professor in the University of Chicago:* "It is a pleasure and a relief at last to see a book of this kind which is not a miserable compilation from end to end, but a thoroughly first-class work, which we can conscientiously recommend to our university classes."

A. A. WRIGHT, *Professor in Oberlin College:* "Perhaps the greatest praise that could be given to it is to say that it reflects the spirit of the zoölogy of the present day. . . . The descriptions are very clear, and the whole work is written in a style so lucid and direct that the way to the author's thought is never dubious."

HENRY HOLT & CO., NEW YORK.

—1895.—

FIFTY-FIRST YEAR.

Eclectic Magazine

OF

Foreign Literature, Science, and Art.

"THE LITERATURE OF THE WORLD."

THE ECLECTIC MAGAZINE reproduces from all the leading FOREIGN PERIODICALS those articles of interest or value to AMERICAN READERS. It will endeavor to consult the taste of all thoughtful and intelligent people, and to present impartially the most valuable articles by the ablest writers on both sides of the great questions of the day which are occupying the attention of the literary and scientific world.

The yearly numbers of the ECLECTIC comprise 1728 pages—a carefully selected Library in itself—containing:

SCIENCE, PHILOSOPHY, ESSAYS,
HISTORY, BIOGRAPHY, CRITICISMS,
POETRY, REVIEWS, TRAVELS,
SHORT STORIES.

The following list gives the principal periodicals selected from, and the names of some of the well-known authors whose articles have recently appeared in the ECLECTIC.

PERIODICALS.	AUTHORS.
Westminster Review,	Professor Huxley,
Contemporary Review,	Professor Tyndall,
Fortnightly Review,	Professor Max Muller
The Nineteenth Century,	J. Norman Lockyer, F. R. S.,
Popular Science Review,	James Bryce, M. P.,
Blackwood's Magazine,	James Anthony Froude,
Cornhill Magazine,	W. H. Mallock,
Macmillan's Magazine,	Herbert Spencer,
New Review,	T. P. Mahaffy,
National Review,	Sir Robert Ball,
Chambers's Journal,	Prince Kropotkin,
Temple Bar,	Archdeacon Farrar,
The Academy,	St. George Mivart,
The Athenæum,	Rev. H. R. Haweis,
Public Opinion,	Frederic Harrison,
Saturday Review,	Mrs. Oliphant,
The Spectator, etc., etc.	Mrs. Andrew Crosse, etc., etc.

The aim of the ECLECTIC is to be instructive and not sensational, and it commends itself particularly to Teachers, Scholars, Lawyers, Clergymen, and all intelligent readers who desire to keep informed of the intellectual progress of the age.

With the ECLECTIC and one good American Monthly, the reader will be fully abreast of the times.

TERMS: Single copies, 45 cents; one copy one year, $5.00. Trial subscription for three months, $1.00. The ECLECTIC and any $4.00 Magazine to one address, $8.00. POSTAGE FREE TO ALL SUBSCRIBERS.

E. R. PELTON, Publisher, 144 Eighth Street, New York.

ACTUAL AFRICA;

Or, The Coming Continent.

A TOUR OF EXPLORATION.

By FRANK VINCENT,

Author of "Around and About South America," "In and Out of Central America," etc.

With Map and 100 Full-page Illustrations.

8vo. Cloth, $5.00.

THIS thorough and comprehensive work furnishes a survey of the entire continent which this experienced traveler has circumnavigated in addition to his inland explorations. The latter have included journeys in northern Africa, Madagascar, southern Africa, and an expedition into the Congo country which has covered fresh ground. His book has the distinction of presenting a comprehensive summary instead of offering an account of one special district. It is more elaborately illustrated than any book upon the subject, and contains a large map carefully corrected to date.

"Frank Vincent is an indefatigable traveler, a keen observer, and a graphic and entertaining writer, and thus combines qualities which afford a ready explanation of the large popularity of his books."—*Boston Journal.*

"He not only shows unmistakable signs of the genius of the born traveler, but gives us information that is fresh, and full of deep interest."—*New York Independent.*

"Few living travelers have had a literary success equal to Mr. Vincent's."—*Harper's Weekly.*

"A new volume from Mr. Frank Vincent is always welcome, for the reading public have learned to regard him as one of the most intelligent and observing of travelers."—*New York Tribune.*

"Any one who has read one of the books of Frank Vincent, who first made a hit with 'The Land of the White Elephant,' will always take another on trust, confident that it will be full of interest."—*San Francisco Chronicle.*

"Mr. Frank Vincent's books of travel merit to be ranked among the very best, not only for their thoroughness, but for the animation of their narrative, and the skill with which he fastens upon his reader's mind the impression made upon him by his voyagings."—*Boston Saturday Evening Gazette.*

New York: D. APPLETON & CO., Publishers, 72 Fifth Avenue.

N. Y. PHOTOGRAVURE CO.

Publishers of SUN & SHADE.

137 West 23d Street,
New York.

Photographs in Colors.

We are now prepared to produce reproductions in colors, of any desired subject, by our photogelatine process, in large or small numbers, and with uniformity, both by hand and improved power presses, which we are now adding to our plant.

Photogravures, Plain and in Colors.

We have the largest and most complete photogravure plant in the country, and by recent improvements (patent applied for) we produce improved plates at greatly reduced prices. From the superior quality of these plates, photogravure printing can also be done at lower prices than formerly. We also make photogravures in tints and colors of excellent quality at reasonable rates.

Photogelatine Printing.

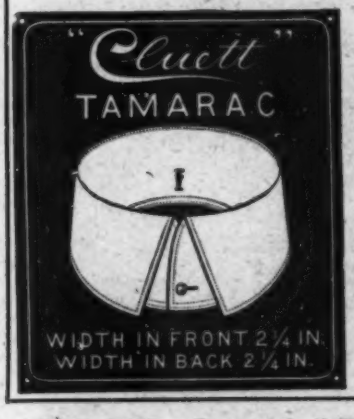
We continue to do the highest class of work by the photogelatine process, which still maintains its superiority over all other processes for extreme delicacy and photographic fidelity.

Correspondence solicited, and sample copies of our Magazine "Sun and Shade," containing specimens of all classes of our work, forwarded on receipt of half the price (20 c.).

We have a large number of subjects from which we can supply editions suitable for book illustrations, calendars, menus, etc., etc.

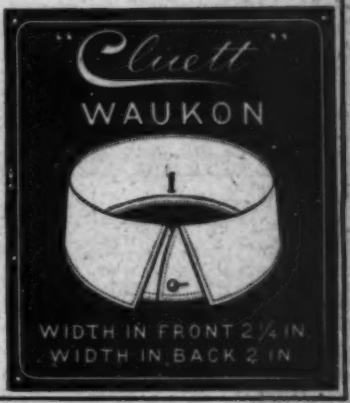
AT
•
YOUR
•
OUT-
•
FITTERS

THE Cluett BRAND.



CLUETT,
COON
& CO.,
Makers.

FACTORIES,
TROY, N. Y.



THE LAND OF THE SUN.

Vistas Mexicanas.

BY CHRISTIAN REID, author of "The Land of the Sky," "A Comedy of Elopement," etc.

Illustrated. 12mo. Cloth, $1.75.

"A delightful, breezy sketch of travel, interesting in its well-told incidents, and valuable for its description of places and people and for its choice scraps of history."—*Chicago Inter-Ocean.*

"In every way a charming book; delightful in its inspiration, most satisfactory in execution."—*Buffalo Commercial.*

"Perhaps no book of recent date gives a simpler and at the same time more effective picture of this truly beautiful 'Land of the Sun' than is to be found in this striking volume."—*St. Louis Republic.*

"The best written book of Mexican travel that has appeared."—*Jacksonville Citizen.*

AT ALL BOOKSTORES.

D. APPLETON & CO., Publishers, 72 Fifth Avenue, New York.

F. W. DEVOE & CO.

ESTABLISHED 1852

OFFICES: COR. FULTON & WILLIAM STS.

NEW YORK.

ARTISTS' MATERIALS.

SKETCHING OUTFITS

OF ALL KINDS

TUBE COLORS · WATER COLORS · CRAYONS

DRAWING PAPER · CANVAS · BRUSHES · OILS & MEDIUMS ·

MATHEMATICAL INSTRUMENTS

HOUSE PAINTERS' COLORS

FRESCO COLORS · FINE VARNISHES

Correspondence invited · Catalogues of our different departments to responsible parties.

COFFIN · DEVOE & Co. · 176 RANDOLPH ST. · CHICAGO

WALNUT LODGE HOSPITAL,

HARTFORD, CONN.

Organized in 1880 for the special Medical Treatment of **ALCOHOL** and **OPIUM INEBRIATES.**

ELEGANTLY situated in the suburbs of the city, with every appointment and appliance for the treatment of this class of cases, including *Turkish, Russian, Roman, Saline,* and *Medicated Baths.* Each case comes under the direct personal care of the physician. Experience shows that a large proportion of these cases are curable, and all are benefited from the application of exact hygienic and scientific measures. This institution is founded on the well-recognized fact that *Inebriety* is a *disease* and *curable,* and all *these cases* require *rest, change of thought and living,* etc.

At Murray Hill Hotel, New York city, the second Tuesday of each month, from 12 to 4 P. M.

Applications and all inquiries should be addressed

T. D. CROTHERS, M. D.,

Sup't Walnut Lodge, Hartford, Conn.

THE NEW YORK MEDICAL JOURNAL.

A Weekly Review of Medicine.

Edited by FRANK P. FOSTER, M. D.

The volumes begin with JANUARY and JULY of each year. Subscriptions can be arranged to begin with the volume. **Subscription price, $5.00 per annum.**

D. APPLETON & CO., PUBLISHERS,

72 Fifth Ave., New York.

Webster's International Dictionary

Specimen pages, etc., sent on application.

Successor of the "Unabridged."

Invaluable in Office, School, and Home.

Standard of the U. S. Supreme Court, of the U. S. Gov't Printing Office, and of nearly all Schoolbooks. Warmly commended by every State Superintendent of Schools.

THE BEST FOR PRACTICAL PURPOSES

It is easy to find the word wanted.
Words are given their correct alphabetical places, each one beginning a paragraph.

It is easy to ascertain the pronunciation.
The pronunciation is indicated by the ordinary diacritically marked letters used in the schoolbooks.

It is easy to trace the growth of a word.
The etymologies are full, and the different meanings are given in the order of their development.

It is easy to learn what a word means.
The definitions are clear, explicit, and full, and each is contained in a separate paragraph.

G. & C. Merriam Co., Publishers, Springfield, Mass.

THE PSYCHIC FACTOR.

AN OUTLINE OF PSYCHOLOGY. By CHARLES VAN NORDEN, D. D., LL. D., late President of Elmira College. 12mo. Cloth, $1.25.

This, the latest treatise on a subject that is now engaging the attention of all educators and philosophers, is a most admirable summing up of the extended discussions and investigations that have been carried on in the field of psychological research up to the present time. The purpose and spirit of the book are strictly scientific, and are intended to embody the trustworthy results of safe thought in the realm of current psychology. It is the most readable and entertaining work of the kind that has appeared, and one that may be perused with interest and profit not only by students, to whom it is especially addressed, but by all intelligent persons.

New York: D. APPLETON & CO., 72 Fifth Avenue.

THE SOCIAL ECONOMIST

Prof. GEORGE GUNTON, Editor.

It is subscribed for and read by the leading FINANCIERS, THINKERS, LABOR REFORMERS, BANKERS, MANUFACTURERS, FARMERS, and STATESMEN.

By the Legislators of Canada, Dr. PARKHURST, THOS. B. REED, and *all who make things go.*

It is in touch with WAGE WORKERS, TRADES UNIONS, INVESTIGATORS, PIONEERS IN THOUGHT, and with all PROGRESSIVE FORCES.

It strikes from the shoulder, and aims at practical results.

It exposes all sham *Economic Panaceas.* It FAVORS ORGANIZATION OF LABOR, and SECURITY TO CAPITAL. Low rates of interest, and free competition in Banking. Protection to American Industries, and PENSIONS TO OLD AGE.

The RETIREMENT OF THE GREENBACK CURRENCY, and the Federation of American Banking in a manner to utilize Gold, remonetize Silver, expand and improve the Currency, and insure the active circulation of Coin, the restoration of Credit, and the revival of societary activity, now paralyzed by economic blunders, and a return to Industrial Prosperity.

Send Twenty-five cents for three months' trial to

PUBLISHERS SOCIAL ECONOMIST,

34 UNION SQUARE, NEW YORK.

—SPECIAL INDUCEMENTS TO AGENTS IN ALL LARGE CITIES.—

Bound Volumes, $1.50 each.

SEND FOR SUBSCRIPTION PREMIUM OFFER.

New Edition of Professor Huxley's Essays.

Collected Essays.

By THOMAS H. HUXLEY. New complete edition, with revisions, the Essays being grouped according to general subject. In nine volumes, a new Introduction accompanying each volume. 12mo. Cloth, $1.25 per volume.

The volumes already issued are as follows:

Vol. I.—**Method and Results.**

Vol. II.—**Darwiniana.**

Vol. III.—**Science and Education.**

Vol. IV.—**Science and Hebrew Tradition.**

Vol. V.—**Science and Christian Tradition.**

Vol. VI.—**Hume.**

Vol. VII.—**Man's Place in Nature.**

Vol. VIII.—**Discourses, Biological and Geological.**

Vol. IX.—**Evolution and Ethics, and Other Essays.**

NEW YORK HERALD.

"Mr. Huxley has covered a vast variety of topics during the last quarter of a century. It gives one an agreeable surprise to look over the tables of contents and note the immense territory which he has explored. To read these books carefully and studiously is to become thoroughly acquainted with the most advanced thought on a large number of topics."

CHICAGO TIMES.

"The series will be a welcome one. There are few writings on the more abstruse problems of science more adapted to reading by the general public, and in this form the books will be well in the reach of the investigator. . . . The revisions are the last expected to be made by the author, and his introductions are none of earlier date than a few months ago [1893], so they may be considered his final and most authoritative utterances."

For sale by all booksellers; or will be sent by mail on receipt of price by the publishers,

New York: D. APPLETON & CO., 72 Fifth Avenue.

A BOOK FOR THE MOUNTAINS AND THE SEA-SIDE.

Astronomy with an Opera-Glass:

A Popular Introduction to the Study of the Starry Heavens with the Simplest of Optical Instruments.

WITH MAPS AND DIRECTIONS TO FACILITATE THE RECOGNITION OF THE CONSTELLATIONS AND THE PRINCIPAL STARS VISIBLE TO THE NAKED EYE.

BY GARRETT P. SERVISS.

DELTA CANIS MAJORIS AND ITS NEIGHBORS.
(From "Astronomy with an Opera-Glass.")

"I have always looked at the heavens wistfully, but have hitherto found nobody to give me a pleasant introduction to the untechnical and easily understood facts of astronomy. I had therefore come to feel that, inasmuch as I could not attack the science with professional purpose and vigor, I must be content to let it alone wholly. Your book has given me just the helpful hand I had for many years longed to get hold of. It seems as if written expressly for *me*, and I want to thank you warmly for writing it. . . . Doubtless there are hundreds of others whose case is like my own; I can wish all such no better fortune than to come across a copy of your ingenious and charming little book."—*Extract from a Private Letter to the Author.*

"It is the first book which we have noticed that gives due praise to the opera-glass as a means of enjoying the stars. And, take it all in all, it is what Karl Wilbur would call the most 'human' book on the subject that we have seen; its style is agreeable, readable, lively, never dull, and never over-rhetorical. It is full of clear sketches of the ancient literature of the stars, and also shows a thorough acquaintance with astronomy as known in 1888. The illustrations are also good, and will be a sufficient aid to one seeking to use the book as it ought to be used, namely, as a practical guide to the enjoyment of the heavens through an opera-glass."—*The Literary World, Boston.*

"Mr. Garrett P. Serviss, a well-known lecturer and writer on astronomical topics, has prepared a most interesting and even fascinating book called 'Astronomy with an Opera-Glass.' In it he shows how with this simplest of optical instruments one can study the heavens with constantly increasing wonder and delight."—*The Christian Union, New York.*

"The author has opened up a new field of rational pleasure to all who can share his enthusiasm and will follow his instructions."—*Journal of Commerce, New York.*

"This book ought to make star-gazing popular. . . . A glass need cost no more than two or three theatre tickets, while for an observatory the roof of a city house, just as it is, is sufficient, though any place out of doors in the country is better."—*The New York Herald.*

One Volume, 8vo, cloth. Price, $1.50.

D. APPLETON & CO., Publishers,
72 Fifth Avenue, New York.

MESSRS. D. APPLETON & CO.

HAVE JUST ISSUED A

TITLE LIST

OF

STANDARD WORKS

For High School and College Use.

It covers a large field of study, and is a valuable index for teachers and students in search of the best text-book literature and books of reference. Send for it. No charge.

D. APPLETON & CO., PUBLISHERS,
72 FIFTH AVENUE, NEW YORK.

SEVENTH EDITION.

ROUND THE RED LAMP.

By A. CONAN DOYLE, M. D.,

Author of "The White Company," "The Adventures of Sherlock Holmes," "The Refugees," etc.

12mo, 307 pages. Cloth, $1.50.

The "Red Lamp," the trade-mark, as it were, of the English country practitioner's office, is the central point of these dramatic stories of professional life. There are no secrets for the surgeon, and, a surgeon himself as well as a novelist, the author has made a most artistic use of the motives and springs of action revealed to him in a field of which he is the master.

"Every page reveals the literary artist, the keen observer, the trained delineator of human nature, its weal and its woe. . . . Dr. Doyle has a rich note-book, or, we should say, a golden memory."—*London Freeman's Journal.*

"A volume of bright, clever sketches, which contains some of the gifted author's best work."—*London Daily News.*

"The reader will find in it some perfectly constructed short stories, the memory of which will haunt him long after he has laid it down. The author again reveals himself as a keenly sympathetic observer of life and a master of vigorous, impressive narrative."—*Yorkshire Post.*

"These tales are skillful, attractive, and eminently suited to give relief to the mind of a reader in quest of distraction."—*London Athenæum.*

New York: D. APPLETON & CO., 72 Fifth Avenue.

Here at Last!!

Fits the Vest Pocket.

Watch Camera.

The very thing for BICYCLISTS, Ladies, and for all who desire a really efficient photographic apparatus, free from objectionable bulk, weight, and trouble. Pictures 1¼ inches diameter. Not a toy. A CAMERA IN A WATCH-CASE. A child can understand and work it.

Send to us for free illustrated booklet. Price, with one Film-holder, $5.00. Films, per doz., 25 cts.

E. & H. T. ANTHONY & CO., - - 591 Broadway, New York.

Marshall's Catarrh Snuff has never been equaled for instant relief of Catarrh, Cold in the Head, and Headache. Cures Deafness, restores lost sense of smell. Sixty years on the market. All Druggists sell it. 25c. per bottle. F. C. KEITH, Manufacturer, Cleveland, O

ARNICA TOOTH SOAP

BY FAR THE BEST dentifrice; antiseptic—harmless—effective. No soapy taste. A trial will make you its lasting friend. *Substitutes are not "as good."* All druggists or by mail 25c. C. H. Strong & Co., Chicago.

APPLETONS'

GENERAL GUIDE TO THE UNITED STATES.

With numerous Maps and Illustrations. New edition, revised to date. 12mo. Flexible morocco, with tuck, $2.50. (Part I, separately, NEW ENGLAND AND MIDDLE STATES AND CANADA, cloth, $1.25. Part II, SOUTHERN AND WESTERN STATES, cloth, $1.25.) *At all Bookstores.*

Kuyler's

COCOA-CHOCOLATES

For Eating & Drinking

Purity of Material and Deliciousness of Flavor Unexcelled

For Sale at our Stores & by Grocers everywhere. ASK For *Kuyler's* the one Cocoa or Chocolate

---

THE LEADING CONSERVATORY OF AMERICA.

CARL FAELTEN, Director.

Founded by E. Tourjée in 1853.

New England Conservatory

Franklin Sq., OF MUSIC. Boston, Mass.

Send for Prospectus giving full information.

FRANK W. HALE, General Manager.

The Ice Age in North America,

AND ITS BEARINGS UPON THE ANTIQUITY OF MAN.

By G. FREDERICK WRIGHT,

Professor in Oberlin Theological Seminary.

With an Appendix on "THE PROBABLE CAUSE OF GLACIATION," by WARREN UPHAM, Assistant on the United States Geological Survey. With 150 Maps and Illustrations. New edition, containing a summary of important discoveries of the last two years.

8vo. 640 pages. Cloth, $5.00.

"Not a novel in all the list of this year's publications has in it any pages of more thrilling interest than can be found in this book by Prof. Wright. There is nothing pedantic in the narrative, and the most serious themes and startling discoveries are treated with such charming naturalness and simplicity, that boys and girls, as well as their seniors, will be attracted to the story and find it difficult to lay it aside."—*New York Journal of Commerce.*

New York: D. APPLETON & CO., 72 Fifth Avenue.

BUFFALO LITHIA WATER

Spring No. 1.—In Chronic Dyspepsia, Renal Calculi, &c.

THE PATIENT GAINS 114 POUNDS IN FLESH.

Mr. W. H. Gregory, *of Stovall, N. C. Stated by Dr. F. R. Gregory, of Stovall, N. C.*

"Mr. W. H. Gregory, a sufferer from **chronic dyspepsia, chronic liver disease,** almost resulting in **granular degeneration,** Chronic Diarrhœa, with Kidney complications, fits of **renal colic,** passages of **Calculi,** and all the worst and most distressing forms of **Gastro-Intestinal** Disorders, after having exhausted the catalogue of *Dietetics* and *Materia Medica* and *Therapeutics*, under the advice and treatment of a number of the most skillful and experienced physicians, without benefit, and having the meanwhile declined, from a normal weight *of two hundred and twenty* to *one hundred and six pounds*, has been completely restored to vigorous health by a visit of three months to the **Buffalo Lithia Springs** and the free use of the water of Spring No. 1 *to the exclusion of all other remedies*, gaining while at the Springs **seventy-two pounds** in weight and in six months thereafter **forty-two pounds** additional. The transition from a state of *cadaveric emaciation* to a new life of robust health and strength in so short a time seems little short of miraculous."

Dr. David E. Smith, *Oakley, Virginia.*

"My daughter suffered from **Chronic Dyspepsia.** She became emaciated and feeble, and her condition alarming. The most approved treatment of the profession proving unavailing, I carried her upon a bed to the **Buffalo Lithia Springs,** upon a diet of *Tea* and *Crackers*, and *Bread* and *Milk*, the stomach often rejecting these, and put her exclusively upon the water of the old Spring (No. 1), the beneficial action of which was soon apparent. Under continued use of the water there was marked and continued improvement, until she was able to eat heartily and digest readily any ordinary article of food. In less than two months she returned home fully restored."

This Water is for sale by druggists generally, or in cases of one dozen half-gallon bottles $5.00 f.o.b. at the Springs. Descriptive pamphlets sent to any address.

THOMAS F. GOODE, Proprietor, Buffalo Lithia Springs, Va.

KINDERGARTEN MAGAZINE. $2.00 per year. *A Monthly for Parents and Teachers. Edited by Andrea Hofer and Amalie Hofer, Chicago.*

Devoted to kindergarten theory and practice. Keeps its readers in touch with the best demonstrations in the entire kindergarten field. New kindergarten songs. Nature studies and investigation. Typical work with gifts and materials. Discussions by live educators on best methods. Psychology made practical by the study of the child. Typical stories by active kindergartners. How to study Froebel's Mother-Play Book.

DEPARTMENT FOR PARENTS.—Correspondence with mothers, discussing all practical and vexing questions. Typical chats with the children on natural history, domestic life, stories, songs, and plays. Hints of how to keep active fingers employed. Hand work and busy ways for children in the home, adapted to the needs of busy mothers. How and why to answer children's questions. Lullabys, home songs, and nursery rhymes.

A pure home magazine, with a high standard of family life as its objective point, and sound purposes in early education. Thinking mothers are most practically supported in their efforts to give children rational training.

Send 15 one-cent stamps for sample, and ask for plans for introducing the KINDERGARTEN into your neighborhood. **KINDERGARTEN LITERATURE CO., Chicago.**

CHILD-GARDEN. $1.00 per year. *A Monthly Kindergarten Magazine for Children. Edited by Andrea Hofer and Amalie Hofer.*

The only magazine for children, gathering up the pure literature of the current kindergartens. No other children's magazine discriminates so scientifically in its choice of contents, having a deep purpose behind all that it brings to the child. Full of helps to kindergartners and mothers. Written entirely by kindergartners from their daily experience. Beautiful illustrations, myth stories, science stories, trade stories, games, songs, talks, Sunday lessons, busy work, letters of travel, blackboard lessons, drawing, kindergarten occupations, etc. Send 10 one-cent stamps for a sample. Any one desiring to get up a club for the purpose of popularizing the kindergarten in any community, write for rates and suggestions to the KINDERGARTEN LITERATURE CO., CHICAGO.

RECENT ECONOMIC CHANGES

And their Effect on the Production and Distribution of Wealth and the Well-Being of Society.

BY DAVID A. WELLS.

12mo. Cloth, $2.00.

THERE is a general agreement, among all qualified to judge, that this book exhibits and explains more clearly than any other one publication the comparatively recent extraordinary and world-wide decline in prices, or helps to a popular understanding of the much discussed and little understood silver problem.

A member of the recent British Cabinet writes:

"The American book 'Economic Changes' has been only recently brought to my attention. I am surprised at this, for it is so full of interest and instruction, and discusses so clearly the leading economic questions of our time, that it ought to have had great popular appreciation."

The President of one of the leading Colleges, under date of September —, writes as follows:

"When I went on my summer vacation I took with me 'Recent Economic Changes,' which I had long intended to read. It interested me greatly, and made an impression that I shall always retain. Such a book, so full of facts and conclusions, and hopeful and sound propositions, is worth a whole library of modern sociological gush.

"My friend Prof. ——, with whom I discussed the book while I was reading it, made the remark that every member of Congress ought to be familiar with its contents. I told him I supposed knowledge on these subjects was not what they wanted; but I confessed to a secret feeling, that if every member of Congress were compelled to read the book it would be worth a liberal education to him."

New York: D. APPLETON & CO., 72 Fifth Ave.

VOL. XLVII.] ESTABLISHED BY EDWARD L. YOUMANS. [No. 6.

THE POPULAR SCIENCE MONTHLY.

GENERAL LIBRARY, UNIV. OF MICH. 2 OCT 1895

OCTOBER, 1895.

EDITED BY WILLIAM JAY YOUMANS.

CONTENTS.

PAGE

I. New Chapters in the Warfare of Science. XX. From the Divine Oracles to the Higher Criticism. V. Victory of the Scientific and Literary Methods. By ANDREW D. WHITE, LL. D., Ph. D. 721
II. Professional Institutions. VI. Man of Science and Philosopher. By HERBERT SPENCER. 739
III. Trout Culture. By FRED MATHER. (Illustrated.) 749
IV. Recent Recrudescence of Superstition. I. By Prof. E. P. EVANS. 761
V. Thomas Henry Huxley. By Prof. MICHAEL FOSTER. 776
VI. Pleasures of the Telescope. VII. Pisces, Aries, Taurus, and the Northern Stars. By GARRETT P. SERVISS. (Illustrated.) 783
VII. The Life of Water Plants. By M. BÜSGEN. 798
VIII. Studies of Childhood. XI. Material of Morality. (Continued.) By JAMES SULLY, M. A., LL. D. 808
IX. Hunting with Birds of Prey. By M. EDOUARD BLANC. (Illus.). 818
X. War as a Factor in Civilization. By CHARLES MORRIS. 823
XI. Sketch of David Hosack. (With Portrait.) 834
XII. Editor's Table: Science and Nescience.—The Path of Scientific Advance.—The American Association at Springfield. 843
XIII. Literary Notices 848
XIV. Popular Miscellany 856
XV. Notes 863
XVI. Index to Vol. XLVII 865

NEW YORK:
D. APPLETON AND COMPANY,
72 FIFTH AVENUE.

SINGLE NUMBER, 50 CENTS. YEARLY SUBSCRIPTION, $5.00.

COPYRIGHT, 1895, BY D. APPLETON AND COMPANY.
Entered at the Post Office at New York, and admitted for transmission through the mails at second-class rates.

HAVE YOU READ—

MENTONE, CAIRO, AND CORFU.

By CONSTANCE FENIMORE WOOLSON, Author of "Anne," "East Angels," "For the Major," etc. Illustrated. Post 8vo, Cloth, Ornamental.

A CUMBERLAND VENDETTA,

And Other Stories. By JOHN FOX, Jr. Illustrated. Post 8vo, Cloth, Ornamental.

ABOUT PARIS.

By RICHARD HARDING DAVIS, Author of "The Princess Aline," "The Exiles, and Other Stories," etc. Illustrated by Charles Dana Gibson. Post 8vo, Cloth, Ornamental, $1.25.

OTHER TIMES AND OTHER SEASONS.

By LAURENCE HUTTON, Author of "From the Books of Laurence Hutton," "Literary Landmarks of Jerusalem," etc. 16mo, Cloth, Ornamental, $1.00. (In the Series "Harper's American Essayists.")

AGAINST HUMAN NATURE.

A Novel. By MARIA LOUISE POOL, Author of "Roweny in Boston," "Dally," "The Two Salomes," etc. Post 8vo, Cloth, Ornamental.

THE VEILED DOCTOR.

A Novel. By VARINA ANNE JEFFERSON DAVIS. Post 8vo, Cloth, Ornamental, $1.25.

SNOW-SHOWS and SLEDGES.

A Sequel to "The Fur-Seal's Tooth." By KIRK MUNROE. Illustrated. Post 8vo, Cloth, Ornamental.

THE FRONT YARD,

And Other Italian Stories. By CONSTANCE FENIMORE WOOLSON. Illustrated. 16mo, Cloth, Ornamental, $1.25.

RHYMES OF OUR PLANET.

By WILL CARLETON. Illustrated. Post 8vo, Cloth, Ornamental, $1.25.

MY LADY NOBODY.

A Novel. By MAARTEN MAARTENS, Author of "An Old Maid's Love," etc. Illustrated. Post 8vo, Cloth, Ornamental, $1.75.

PONY TRACKS.

Written and Illustrated by FREDERIC REMINGTON. 8vo, Cloth, Ornamental, $3.00.

OAKLEIGH.

By ELLEN DOUGLAS DELAND. Illustrated. Post 8vo, Cloth, Ornamental.

NEW EDITION OF NOVELS BY THOMAS HARDY.

Each Volume contains an Etched Frontispiece and a Map of Wessex.

TWO ON A TOWER. Crown 8vo, Cloth, $1.50.

A PAIR OF BLUE EYES. Crown 8vo, Cloth, $1.50.

FAR FROM THE MADDING CROWD. Crown 8vo, Cloth, $1.50.

THE MAYOR OF CASTERBRIDGE. A Story of a Man of Character. Crown 8vo, Cloth, $1.50.

RETURN OF THE NATIVE. Crown 8vo, Cloth.

THE MASTER.

A Novel. By I. ZANGWILL, Author of "Children of the Ghetto," etc. Illustrated. Post 8vo, Cloth, Ornamental, $1.75.

HARPER & BROTHERS, Publishers, New York.

Degeneration.

By Prof. MAX NORDAU. Translated from the second edition of the German work.

8vo. Cloth, $3.50.

Philadelphia Telegraph.

"The intense interest currently shown in the subject treated in the book, the original ideas it offers, and the imperturbable spirit of the scientific investigator which animates and sustains the author, will unquestionably command for it in this country the attention it has received abroad; and it may be safely predicted that 'Degeneration,' already known here in literary circles, is destined to attain an immediate and widespread popularity."

Cincinnati Commercial-Gazette.

"This fascinating and most suggestive book gives a picture of the æsthetic manifestations of the times, drawn with rare adroitness, vigor, and command of satire, and it will be found to hold a place which has not been occupied."

AT ALL BOOKSTORES.

D. APPLETON & CO., Publishers,
72 Fifth Avenue, New York.

Sir Morell Mackenzie

M. D.,
WROTE OF

VIN MARIANI

THE IDEAL TONIC:

"I have used 'Vin Mariani' for many years, and consider it valuable and particularly serviceable."

Mailed Free.
Descriptive Book with Testimony and
Portraits
OF NOTED CELEBRITIES.

Beneficial and Agreeable.
Every Test Proves Reputation.

Avoid Substitutions. Ask for 'Vin Mariani.'
At Druggists and Fancy Grocers.

MARIANI & CO.,

PARIS: 41 Bd. Haussmann. LONDON: 239 Oxford Street. 52 W. 15th St., New York.

A SUPERB EXHIBIT OF

JOSEPH GILLOTT'S STEEL PENS,

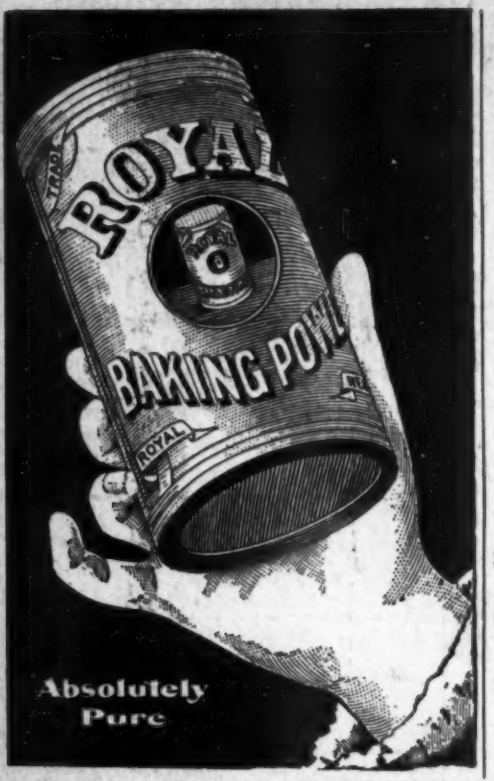
PRIZE WINNERS AT PARIS,

RECEIVED THE AWARD AT THE

WORLD'S COLUMBIAN EXPOSITION,

CHICAGO.

When you need a first-class Pen,
ASK FOR GILLOTT'S.



IVORY SOAP

99 44/100 PURE

"Men should be what they seem" and so should soaps, but Ivory is the only soap that is 99 44/100 per cent pure.

THE PROCTER & GAMBLE CO., CIN'TI.

The ONLY AMERICAN GENERAL GUIDE-BOOKS to the United States and Canada.

Appletons' General Guide-Books to the United States.

ILLUSTRATED. TWO VOLUMES.

New England and Middle States, 1 Vol., $1.25.
Western and Southern States, 1 Vol., $1.25.
Complete in One Volume, $2.50.

Appletons' Hand-Book of Summer Resorts.

ONE VOLUME. PAPER, 50 CENTS.

A clear, compact, and readable account of the great Watering-Places and leading Resorts of the Summer Tourist.

GUIDE TO CANADA.

Giving full descriptions of Fishing and Shooting Grounds, Resorts, etc.

WITH MAPS AND ILLUSTRATIONS. FLEXIBLE CLOTH, $1.50.